Ontario Curriculum Guidelines
Primary & Junior Divisions

Support Documents
1975

Contents:

SUPPORT DOCUMENT

Support Document #2

Movement

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Support Document #2

Movement

This unit explores shape and uses it as a theme to link different approaches to movement. Shape through gymnastics, shape through games, and shape through dance are developed in different ways. The lesson on gymnastics uses a directed approach, while the sections on games and dance are progressively more flexible.

Since the concept of shape underlies much of the work in Environmental Studies, the Arts, and Communication, each section of this booklet indicates a few possible applications of the basic theme in other areas of study. It is assumed that the teacher will integrate these within the total program. There are many words used throughout this unit that would be appropriate for subsequent language experience.

In all three areas, the teacher might motivate the children by reading a story about shape; several are suggested in the bibliography at the end of this appendix.

Shape through Gymnastics

The lesson in gymnastics begins with the practice of a familiar activity that does not require apparatus. The teacher should specify these activities before the children leave the classroom so that they may begin immediately on entering the gymnasium. Children enjoy repeating tasks which they have performed successfully; it gives them a feeling of security. In

this case the teacher could profitably relate the activity to the story that has just been read. A scatter formation is recommended for most activities in this lesson.

Activities along the floor

In this section as in several others, prepositions are used as key movement words: along the floor, off the floor, and so on. In essence, children will be applying the principles of shape (or of space awareness) to their activities on the floor.

Travelling could include walking, running, skipping, and hopping, and the teacher might encourage the children to use parts of their bodies other than their feet; they might move on their stomachs, hands, or knees, for example. Using their chosen forms of locomotion, the children can explore patterns and pathways: round shapes, square shapes, or twisty shapes. In outlining imaginary shapes on the floor, the children should be well spaced and should use light resilient movements.

Rolling can be accomplished on the floor using mats, or outside on the grass if there are no mats. If mats are used, they should all point in one direction and they should be well spaced. Activities could include: making the body into a shape that will roll along the mat or ground; rolling in a different shape; rolling smoothly (practising to make the roll better); and,

finally, making a pattern with rolling movements. The teacher will watch the children and the children will watch each other. On the basis of the observations they make, children will discuss such points as: what is a good roll? are some rolls better than others? what different shapes were attempted (round, long, thin, oval, in rolling forward, backward and sideways)?

Activities on the floor

Movement under this heading would include activities in which the body rests on the hands, the feet being off the floor momentarily. (The children should be encouraged to bring their feet down softly.) The teacher could ask the children to move their legs while their hands are on the floor, then make shapes with their legs. Shapes might be wide, curled, twisty, long, thin, symmetrical, or asymmetrical. The latter two are big words for little people but they have great significance in both movement and the visual arts, and children will soon learn what they mean once they have felt what it is like to be symmetrical or asymmetrical.

Activities off the floor

The first activity under this heading would be to jump as high as possible and to land safely and softly. In fact, the

children could learn the words light and resilient by trying to land that way. Landings are important, not only for safety, but for the control necessary to lead into another movement. Second, the children could jump to make a shape in the air: wide, long, thin, or curved. The teacher should encourage children to do their best at all times; they should aim for quality in the stretching and curled shapes.

Activities with small apparatus (skipping ropes)

Teachers need patience in helping children to skip rope. It is a highly complex activity for young children, involving a considerable degree of neuromuscular control. Here are some suggested activities for this phase of the shape unit:

- free practice of any activity with the skipping rope;
- practice in skipping;
- making the rope into a shape on the floor;
- making the rope into a different shape;
- walking along the rope (an element of balance as well as of shape is involved here);
- jumping into and out of the shape (children should once more land lightly and resiliently);
- jumping over the shape (a consideration here is take-off, that is, whether the child starts the jump from one foot or both feet; he should find out that jumping from one foot to the other foot is a leap);

. changing the rope into a round shape and moving into it and out of it with the body's weight on the hands.

Group Activities

For group work, children can rotate among activities in various parts of the gymnasium, so that each child will experience a variety of shapes and movements. There should be no more than four or five children in a group. Here are some suggestions:

Group 1: (Cane, hoop, two individual mats) Move over the cane, using wide body shapes. Jump into and out of the hoop, using thin shapes. Roll on the mats, using round shapes.

Group 2: (Climbing frame and ladder at stretch height) Explore ways of climbing, making your body wide and thin.

Group 3: (Skipping ropes) Practise any familiar activity with a rope.

Group 4: (One bench, one balance bench, two individual mats) Move along the bench; show a variety of shapes; move over and along the balance bench; use the mat for landing and rolling.

Group 5: (Two canes, two hoops) Travel over the two canes, using a weight-on-hands movement; make bridging shapes over and in hoops.

Group 6: (Storming stand and board for a bench inclined up onto an agility box or trestle, two individual mats) Jump from board, make a shape in the air, land softly, roll on the mat.

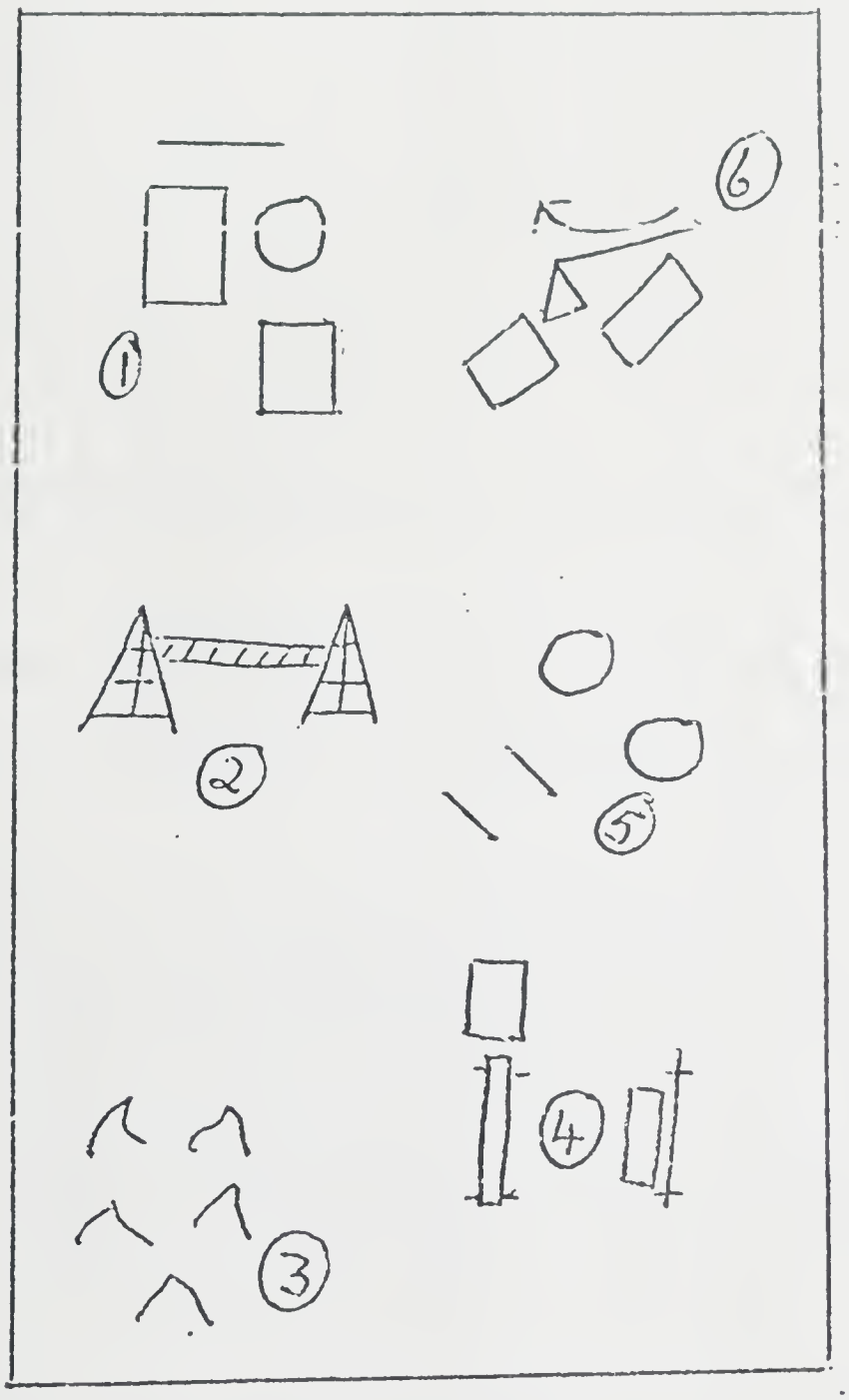
Relaxation: After all apparatus has been put away, find a spot and lie quietly on the floor.

The foregoing is intended as one lesson, but the material can be used several times, with only one or two of the challenges changed. In fact, repetition is essential.

In later lessons, the shape theme may be developed in some or all of the following ways:

- increasing the complexity of apparatus arrangements;
- introducing shape in balancing various body parts;
- linking balance shapes with rolling shapes and jumping shapes, and travelling to make more complex patterns or sequences;
- introducing other small apparatus;
- using shape as the limiting factor in tasks based on other aspects of movement;
- encouraging a higher standard of performance (always compatible with the children's abilities.

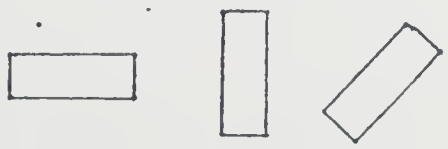
The teacher may also develop the idea of shape in connection with large apparatus such as the box horse, bench, trampette, or mat. All have distinctive shapes.



Suggested layout of gym for group work

Once children are conscious of shape, the concept can be applied in many classroom activities. The following are suggestions as to how ideas of shape can be used in studies of the environment.

Children could:

- explore the shapes of signs and other objects in the environment;
- gauge the number of rectangles in a building;
- investigate how a seed changes shape as it grows into a plant;
- identify animal and bird footprints by shape;
- explore shapes that can be made with a string;
- observe the changing shapes of clouds;
- examine the shapes of containers, bottles, and candles;
- attempt generalizations from shape: why are balloons or balls round?
- classify objects according to shape;
- investigate the functional shapes of objects such as cages, dishes, tools, and books;
- match tools with their silhouettes on the work bench;
- investigate playing areas: circles (sometimes concentric), rectangles (as in basketball and badminton), series of shapes (as in shuffleboard and hopscotch), diamonds, squares, or irregular shapes;
- determine if a shape changes when turned (e.g. are these different shapes? );

- create or invent games: a suggestion such as take your ball, the floor, and the wall and make up a game with them can lead to the creation of many shapes, formations, and floor patterns;
- experiment with the use of balls: making shapes while bouncing and catching (can you make your body wide, thin, round, long, twisted?) pat-bouncing while standing, crouching, kneeling, or lying down (one child makes bridge shapes, partner rolls ball under the bridge, runs round to retrieve), making shapes in three's (one makes body shapes or bridges, partners roll or bounce ball to each other under the arches).

The concept of shape can be applied far beyond the confines of the gymnasium. Some ideas for applying the idea of shape to the study of the environment were given under Shape Through Gymnastics. Here are some further suggestions pertaining to Communications.

The children could:

- select words that suggest shapes;
- experiment with the shape of words, both orally and in writing;
- explore the shape of letters;
- investigate shapes identified from magazine pictures;
- identify shapes within the classroom;

- write their own stories and assemble them in a shape booklet;
- experiment with the shapes of jigsaw puzzle pieces;
- devise games using the shape of the mouth to convey meaning;
- play games of snap using shapes;
- write a story about a movement activity involving the making of shapes;
- construct geometrical shapes;
- classify objects according to shape;
- investigate multiple shapes in a single object (e.g., a funnel).

Games through shape

The theme of shape is used here not as a lesson, as in gymnastics, but as a series of ideas showing the application of shape to aspects of the games program.

It is suggested that a teacher draw from and develop the ideas that are relevant to the needs of the children and to interest already generated. Many of the categories listed below overlap.

Games

- formations: circle, scatter, square, line(s), triangle;
- kinds: circle games (singing and chanting games often have a circle); square games such as Corner Spry, Four Square;

scatter games such as Mr. Wolf, Big "A", Little "A"; line games such as Piggy in the Middle, Two Dogs and a Bone;

- small apparatus: bats and strikers, racquets, the hand as a bat, sticks (hockey, field hockey, plastic, Safe-T-Play hockey), bean bags, hoops, scoops, skipping ropes, quoits (deck-tennis rings), balls (most are round, but they come in many sizes and colours), pylon-type markers, bowling pins, skittles, Indian clubs, detergent bottles), canes;
- targets: goal in hockey and soccer, basket (does it have the same shape with a net?), backboard, bull's eye, targets of various shapes for accuracy-throw (square, rectangle, circle, triangle, face, etc.) pail, carton, suspended hula-hoop.

Shape Through Dance

When a child dances, his inner self speaks, often much more eloquently than it could in words. The purpose of this section is to suggest ways in which an imaginative teacher may develop the concept of shape through dance. These ideas may be adapted to many situations.

Pathways over the floor: A pathway could start and finish in the same place, enclosing a space that is circular or angular. The pathway itself could be curved, meandering, or straight. Children could also consider direction (forward, backward, side-ways) or speed (slow, fast, accelerating).

Body shapes: The limbs could be moved into certain shapes, perhaps as part of activities such as waving good-bye. The whole body could be used to represent shapes (curled-up, extended, arched, twisted, jack-knifed, wide, thin, symmetric, asymmetric). These shapes could be extended to form a dance based on one particular shape, first alone and then with a partner. Then contrasting shapes could be used as the basis of a dance, again alone and with a partner. Finally a whole sequence of shapes could be fashioned into a dance, both solo and in pairs, and the shapes could be formed at various levels, high in the air or near the floor. Another variation would involve combined body shapes: curled body and stretched arms, for example.

Shapes as stimuli: The children could duplicate the shape of sounds they have encountered in other studies (round, long, short) or they could respond to the shape of sounds produced by various instruments. The drum, for example, produces a solid, deliberate sound that can be used to signal changes from one shape to another. The cymbal and the triangle also produce distinctive sounds that the children might interpret as wavy, undulating, fingery, explosive, or delicate, as the case may be. Words can also be used as stimuli; some that lend themselves to interpretation are: gnarled, triangular, arched, and spiral. Trees can also be imitated: poplars, oaks, weeping willows, driftwood. Other objects that can inspire shapes might include buildings, lampshades, and animals. More complex interpretations might lead to a dance based on a story about shape. Such a dance could grow into a dance drama, involving partners using matching or contrasting shapes or perhaps a whole group making square, round, or star shapes. Such a dance could include other stimuli as well: a drum or tambourine could signal a change from one shape to another, for example. After basing a dance-drama on the story with which the unit was started, the children could make up their own stories for interpretation, basing them on shapes that they can duplicate with their bodies. Caves, doorways, imaginary creatures, or implements can all be imitated by the human body.

Some suggestions for exploring areas of the Arts through the concept of shape are given below. Teachers will find many ways to adapt these activities to their own objectives and to the needs and interests of their children. The suggestions are separated only for convenience in planning.

Children could:

- find buildings of different shapes in advertisements;
- cut out shapes and paste them together to form a picture;
- attempt to detect shapes in music and express these in drawings or paintings;
- find shapes in pictures;
- depict the characters in a poem or story in silhouette;
- make shapes with their own mouths;
- find patterns in pictures or in nature;
- make their own patterns with pencils or paints;
- classify musical instruments by shape;
- detect the shapes in familiar rote songs;
- listen for high and low sounds;
- move in shapes to music;
- simulate a shape while others guess what it is;
- dramatize movements of animals;
- blow paint and cut shapes.

Conclusions: The material in this unit relates to one theme, shape. Similar units may be developed on other themes. It should be noted that in this unit, exceptional children can be integrated into regular programs.

Evaluation in this unit is simple: is the child doing his best and enjoying it?

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DRAMA

SUPPORT DOCUMENT #4

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Support Document #4

Drama

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Drama

Story dramatization (enacting) and improvisation (invention) are basically the same thing. The important distinction is the treatment of the story -- whether it is used as a road map for the children to follow or as a springboard for their own inventions.

When stories are the source for work in drama, the teacher may choose to deal with the story line, the characters, the ideas, or the concepts suggested by the narrative.

With younger or less experienced children, it is helpful to use the story as a framework that the children can amplify with details of movement and speech. They need not act out the whole story in sequence; they may probe the story's potential until it has been explored and extended. This technique usually results in much experimentation and rotating of roles as the children bring interesting story moments to life. The security of working with familiar storybook characters and situations is an added benefit.

When children have gained experience in this kind of work, they can begin to work from their own frameworks. The story is still important as a source for ideas, but the children use it to develop their own characters, relationships, circumstances, and situations.

At times each individual will work alone in his own space, at other times with a partner, in a small group or with the whole class, but always without fear of competition, typecasting, or the demands of performance.

A wide range of activities is possible, even for the handicapped child. Some children find talking with a partner difficult, working in a group impossible, and yet derive much benefit from the discussion before, during, and after the mutual experience of drama. The child who is standing doing nothing or hiding under a desk should not be forced to enter the activity. When he feels secure he will enter willingly. The child must also feel free to withdraw if he is having difficulty coping. If such withdrawal is widespread, the activity should be altered immediately. At all times the teacher will have to keep observing, analysing, and assessing what is taking place in order to match the activities to the abilities of the children, expanding their imaginations, praising them for achievements, and recognizing individual differences.

Under such circumstances, all children benefit from drama's extension of stories through movement and speech activities, or through talking quietly with a friend, or through playing out feelings and emotions.

The child not only deepens his appreciation of literature, but adds much to his understanding of himself and others.

In the following action samples, the sources for enacting and inventing will be stories familiar and less familiar. The emphasis will be on involving all the children in the exploration of mood and movement, body and space, talk and silence, gesture and effect, story and laughter, character and moment.

These examples are actual accounts of two lessons in a classroom of eight- and nine-year olds.

ACTION SAMPLE ONE:

The children sit scattered about the room. Nothing has been read to them so far.

The teacher begins:

> Make yourself as small as you can. Make yourself as large as you can. Fill as much space as possible. Make yourself smaller than ever now. Make yourself even bigger than before.

The activity moves along quickly, at a pace that allows the children little time to be concerned with anything but their own activity.

The teacher continues:

> Make yourself very small again. When you hear the rattle of my tambourine, grow very slowly into something quite large -- then freeze the position.

Several children leap to their feet in seconds. The teacher works quietly, speaks slowly, and guides the children through the activity again. Eventually, quiet, slow recorded music is introduced to help the children control their movement.

The children are now motionless. The room is filled with statues of bigness.

Look at the way you are holding yourself. What might you be? Whisper your ideas in my ear as I pass by.

In the early stages of the activity most of the children use space vertically. The teacher continually challenges them to think of other ways to fill the space around them. Some respond by spreading out on the floor; others snake from side to side; one boy tries to walk on his hands. It is interesting to note the efforts of the children, each trying to understand his body and the way it moves.

The children are clustered about the teacher now. They talk about bigness as they have represented it.

Was anyone a troll?

Do you know any stories that have trolls in them?

Only Three Billy Goats Gruff is mentioned.

Tell me that story.

The children describe character, place, and action and blurt out quotes as the story unfolds in jumbled fashion.

Can you tell me the story with your whole body?

Find a partner and build with your bodies the bridge that the troll guarded.

You and your partner join two others and make another bridge using all four bodies.

The work in fours is not successful. Some groups are waging tug of war. A bridge collapses in a heap. The teacher intervenes.

Find your own space again. While I count slowly to three, make a frozen picture of the troll who lives under the bridge you were building.

The teacher moves among the statues making comments of praise on the use of space.

When I strike my tambourine, move your troll about the room. Try to make him move in ways I've never seen before.

A trio of trolls turns on the group, obviously wanting to take on all challengers. The teacher positions himself in front of them screening them from the others. The tambourine clatters violently:

You trolls are all climbing a very treacherous mountain slope. Show me how difficult it is to pick your way along.

The clattering sound continues -- a pace has been established. Trolls struggle up imaginary slopes. One

child simulates a spectacular tumble. He gets little response and starts climbing again.

The teacher has grouped the children in three's. They are creating frozen pictures of trolls guarding a bridge. The groups function well. The children are given only seconds to make their tableaux.

> Make another picture now. This time make it show what happens when someone tries to cross the bridge.

The class creates the picture two or three times, switching roles and testing new ideas. The room is getting noisy but the groups are working well.

> Find a partner quickly. One is X; the other is Y. Decide which is which. X is one of the goats; Y is the troll. What conversation do they have on the bridge? Try it.

Roles are rotated, the scene is replayed a few times but the activity lasts too long and concentration begins to break down. The tambourine sounds:

> It's time to climb back down the mountain, trolls, but all that arguing has made you very tired. Move slowly, carefully.

Tired trolls slip and slither down imaginary slopes. When the bottom is reached they collapse exhausted and lie still.

The children sit around the teacher. They talk about the conversations on the bridge.

Do you remember what the big goat said to the troll in the story?

No one recalls the words exactly. The teacher reads the Marcia Brown version of the story. The language of the story is discussed. The children find it most appropriate. The teacher provides other versions by William Stobbs, Raymond Briggs, and Paul Galdone. Interest quickly switches to what the trolls look like. The children compare the pictures in the different editions.

The teacher reads Terrible Troll by Mercer Meyer. The children gasp at the thought of such an enormous troll. There is much interest in finding more troll stories but for the moment there is paint, paper, and other materials at hand . . ."troll stuff".

ACTION SAMPLE TWO:

The same group of children is involved in this activity. The children have listened to D'Aulaire's Trolls during the past few days. They have been asked to spread out.

I'm going to play a piece of music for you. ("In the Hall of the Mountain King" from Grieg's Peer Gynt suite.) Close your eyes as you listen and think about the trolls we've read about. What kinds do you see? What are they doing?

The children sit quietly, concentrating. The music fades under.

When you are ready, form a picture of the troll you are thinking of and have it do what the music suggests.

The music comes up. The children gradually stir and begin to take on troll shapes. The movement is much more controlled than the last time. Concentration is excellent. The music dies. The room is still. Thirty-two splendid trolls are rooted to the spot.

As I walk among you I can see mountain trolls and river trolls, but I am having difficulty finding troll hags and troll brats and many-headed trolls. When the music starts, practise moving your troll.

The children are trying to use space effectively, but few are experimenting with specific physical features. The teacher asks:

What kinds of things would interfere with the movement of many trolls?

There is much discussion about long noses, many heads, and cumbersome tails.

Together the children try moving with big noses, several heads. Someone suggests they roll some newspaper noses and hold them to their faces. Noses are rolled, the music plays, and movement is started, but concentration is maintained with difficulty Two children sword-fight with their noses in a corner.

Move into groups of three and move in and around each other. Watch each other's movements and don't bump.

Some children discard their noses and try moving with a shoulderful of heads. Others retain their paper props. The teacher continually draws their attention to the movement and admonishes them to slow everything down.

> Now that you have some idea about your troll shape and know how it's best for you to move, create a game with your group that you think trolls might play. Begin to play your game as soon as it is ready.

The groups respond with amazing speed. Games with imaginary balls and other equipment are soon under way. The teacher suggests that chants similar to those used with playground games be added. After a short time the teacher stops the activity.

> As you know, trolls cannot tolerate sunlight. It destroys them, doesn't it? In a moment we'll return to your games. When you hear the gong you will suddenly realize that the sun is rising and you are miles from your cave. As the sun climbs higher, what happens to you? Will you reach safety? Will you die? The music will tell you how bright and warm the sun is getting.

The games begin. A gong sounds. The music begins softly. A few children scramble quickly to the safety of corners and look around not knowing what to do. Some deliberately claw their way across the floor,

showing loss of strength and simulating a desperate struggle to stay alive. The music increases in volume. One child, dazzled by imaginary sunlight, stumbles about in circular patterns, going nowhere. A few children slump lifeless to the floor. A girl tries to haul a friend behind her. One child who bolted quickly to safety re-enters the scene to rescue a friend and expires magnificently. The music soars, then dies. There is silence. The floor is littered with the stonelike remains of trolls. The teacher, obviously delighted, gathers the children round. They all talk at once excitedly about their story. Most want to do it again and add new ideas.

In the days to follow, much work related to the dramatization is undertaken. The fascination with troll hags results in the creation of papier-mâché noses moulded to eye masks. The recorded music is replaced by sound compositions created by groups of children for The Night the Trolls Played Late. Choral chants from troll games printed with magic markers on chart paper line the walls. Throughout all of this the school librarian has been very busy helping some of the children find books related to the experience for their personal reading and providing records such as Siegfried for small groups to listen to and discuss. A future session dealing with mythical creatures in literature is already in progress as mat-

erial for futher drama experience is being gathered by both librarian and children.

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BECOMING A READER

SUPPORT DOCUMENT #5

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Support Document #5

Becoming a Reader

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BECOMING A READER

This booklet describes a unit of study in a class of Primary Division children. A few explanations and philosophical interpolations have been added. Otherwise this is the teacher's record of a unit of work actually presented in class.

Objective: to extend the children's understanding of the thoughts, feelings, and experiences others have expressed in writing and to respond in personal ways to what has been communicated.

Understanding what others have written involves more than the ability to decode and translate printed symbols. As pointed out in Chapter Four, Communication of Education in the Primary and Junior Divisions, the reader must become personally involved in thinking through and reflecting upon the ideas presented. To do this, a child must find a relationship between his language and the language of the author. He must be able to relate the author's ideas to his personal experiences and to search for relevance, make judgements, draw conclusions, and integrate into his own thinking and his own experiences what the author has communicated.

The ideas and impressions a reader receives are of little value to him unless he responds and reacts to them personally. His responses can take any form from a single mental note to a comprehensive report. Through these responses a reader clarifies

and extends his thinking, and accommodates and assimilates the ideas, concepts, and attitudes that are important to him.

It is important to realize that most reading skills, particularly those identified as comprehension and interpretation, develop in a child's daily experience in living. The child who relates to printed symbols with understanding is one who has developed the thinking abilities he requires to understand, interpret, and respond to the people, things, and language within his environment.

Most children become readers as much through their own writing and the writing of their classmates as through printed books. When children write their own ideas on paper and read them to others, they understand the nature of reading and the concept of authorship. Therefore, reading, writing, and other forms of communication must develop side by side.

Each child in this class has hdd a unique set of experiences with the people, places and events of his environment as well as with language and printed symbols. These experiences have influenced the progress each child has made in his attempts to cope with print and to become a reader. Most of them have developed some strategies for decoding printed

symbols and translating them into speech. The following groups of readers can be identified in the class.

Some children are able to use a variety of techniques to break the code and tackle printed materials with zest and excitement. They enjoy playing with the sounds and the rhythms of words, and are constantly in search of new words, phrases, and expressions.

Others are in the process of discovering that there are a variety of strategies to break the code. They have produced a number of simple books and have read their own stories and the stories of their peers. They have collected a large number of words, phrases, and expressions of personal interest to them. Their teachers have extended and enriched this collection by introducing them to a common basic vocabulary. They have used these words in game activities, sorted and classified them into categories, added them to class dictionaries, and used them in their personal writing. These children read a variety of easy-to-read materials independently and meet daily with their teacher to extend their competence in decoding words and to discuss and interpret ideas presented in print.

A few children are experiencing great difficulty in noting the difference between certain speech sounds. They cannot make the fine discriminations needed to respond to and apply phonics.

Through the sound, music, and listening centres, their teacher is providing them with more opportunities to hear and experiment with a variety of sound and speech patterns.

Several children have taken a longer time to develop strategies for decoding words,and at age seven and a half are still in the beginning stages of reading. Their own language and ideas, typed by parent volunteers, is used as reading material. The teacher uses words and phrases from these materials to help the children note specific structural elements within words. The teacher meets them daily to share and interpret a variety of reading materials, gathered from the library and other sources and related to the children's current interests.

Action

A curriculum designed to help children become readers provides numerous opportunities to extend and enrich understanding.

The following episode describes one activity that led to a variety of reading experiences. It began with a walk through the oldest part of town. Thirty-two children accompanied by a teacher, a consultant, and two parent volunteers, and equipped with tape recorders, polaroid cameras, sketch pads, and pencils set out to compare an old neighbourhood to their own. They noted differences in the structure of the houses, streets, buildings, and shops, and listened to the variety of languages spoken.

The children were divided into small groups of eight, each guided by an adult ready to provide the vocabulary needed to describe and explain their observations and experiences. New words and phrases were introduced in a real context and this acquired a very specific meaning for the children.

A new sign, Lacey's Antiques, was mounted in a cutter on the lawn of an old house. It provided one opportunity for exploration and new experiences. Each group visited a different section of the antique store.

One group climbed into the attic to explore new sights, smells, and sensations. Attempts to deduce who might have owned or played

with the treasures they discovered sparked the children's imaginations. They moved into the world of fantasy and imagined other creatures who might still inhabit the attic.

Another group visited the repair shop. They stayed long enough to see a chair being assembled and explore a variety of odours and textures. Ooserving a blind operator caning a chair helped the children to recognize the patience and skill required for this operation.

Another group explored every inch of an old barn still standing behind the antique store. They examined, operated and climbed over a variety of machinery and vehicles: a tractor, a bicycle built for two, a tricycle, a plough, a hayrack, a motorcycle, and an old car.. Comments demonstrated a keen eye for detail as well as imagination.

The fourth group walked through the showroom of treasures, reading signs and explanations, noting prices, and taking pictures. They were attracted to the old school desks and books. They listened to the music from the old victrola, a player piano, and a nickelodeon.

Sharing Experiences and Planning More Action

Responding and reacting to what has been communicated facilitates understanding when personal impressions are clarified and validated through recall, discussion, and expression.

Significant comments recorded on tape recorders were replayed or translated into print by the group leaders. Discussion was in terms of Who said it? When? Why? and facilitated recall. It also provided the teacher with an excellent opportunity to identify strengths and limitations in observation, language, and understanding.

The children represented and expressed ideas gained from the experience in a variety of ways: painting, assembling photographs, construction, and writing. These activities provided the teacher with more clues.

Armed with the information noted during the sharing session, the teacher made plans for integrating the experiences gained at the antique shop into activities to extend understanding. The following has been extracted from her plan book.

The Teacher's Plan

What are the Specific Needs?	Who Requires Help?	How Will It Be Accomplished?
Concepts that require clarification and extension:		
. antique, treasure, collection; . value of old and beautiful things;	Group that viewed the showroom treasures + Group that visited the repair shop	Reading (1) Interpretation of attitudes and feelings in Nuremberg Stove, an old German tale. Begin with a discussion and review of the polaroid pictures, sketches, and paintings done on our excursion yesterday.
	"Bill's special collection"	(2) Introduce the collection of old clothes, baby clothes, records, books.

appreciation of personal pride and pleasure gained by people who collect and refinish old things.	Whole class	(1)Mr. Lacey's visit in a week; (2)collections added to the various areas; (3)discussion in sharing sessions.
<u>Imagination and fantasy, sparked in the attic, requires extending</u>.	Robin's group	Develop a group story about attic creatures. (Begin with polaroid pictures of Lacey's attic and the taped comments.) Robin, Jerry, and Bill had some creative ideas that will be a good beginning.
<u>Specific skills to be taught</u>:		
summarizing and recalling main ideas; organizing information; judging the relevance of statements;	Robin's group	Using the group story, we create and develop information about our creatures and classify it under these headings: appearance, food, homes, travel, play.

. interpreting feelings; . evaluating attitudes;	Whole class	(1) Integrate material gathered above into teaching episodes. (2) Story time: Read Oscar Wilde's <u>The Selfish Giant</u>. (3) View film <u>Merry-Go-Round Horse</u>.
. making comparisons; . noting similarities and differences between the old and the new.	Whole class	<u>Choice Activities</u>: Discuss one area each day. Focus on the new information the children gained in the centre and the comparisons they made themselves.

Materials I Need to Add to the Areas

The Curiosity Area

Mr. Lacey suggested that the children examine his collection of bits and pieces guess what each item is and how it is used, and check it with reference books and old department store catalogues. Make an activity card - add paper and pencils for guesses.

Dress-up Area

Add Mrs. Micheluk's wardrobe trunk and her collection of clothes and jewellery and Mrs. Jones' doll and old baby clothes.

The Reading Area

Add the collection of old readers and texts, photograph album, old magazines, department store catalogues of 1930 and 1973, and My Book of Fairy Tales.

Listening Centre

Add Mr. Wiley's victrola and his collection of records. A concertina, jew's harp, mouth organ, toy horn, and kazoo might introduce new sounds.

Maths Area

Add an activity card for comparing prices in old and new department store catalogues. Reprints are available for the years 1927 and 1935.

Writing Centre

Add straight pens and pen nibs, fountain pens, an ink bottle mounted in a sponge, and more blank booklets.

Plans in Action

The following two-column record is once more from the teacher's file.

Activity	Responses and Reactions
The Nuremburg Stove	
The discussion following the reading of this story allowed the readers to explore the emotions and feelings of the characters involved. They had to come to terms with the fact that beautiful things are important to people and that often treasures are priceless.	Although these children are rich in experiences and language, they could not really understand the feelings of the characters. A role-playing situation was devised to allow the children to be personally involved in a real-life experience with their own treasures.

Activity	Responses and Reactions
	Each child in the group was asked to bring his special treasure to school the next day. I brought my own collection of porcelain birds. After sharing their treasures and exploring their feelings about them, the children were asked by the principal to donate their treasures to his collection of gifts for the poor. The discussion, stories, and dramatic presentations after this episode indicated that this group had grown in understanding of a treasure.
Bill's Special Collection	
Bill's group examined the question of why people collect things and why these collections have personal value to the collectors.	A schedule has been posted for showing collections and treasures. In the process of trying to have parents share personal collections with the class, the children have discovered first hand that people

Activity	Responses and Reactions
	generally attach great value to their collections. In many cases the parents accompanied their collections to school, guarded them, and took them home after their presentation.
	Choice Activities
Mr. Lacey's Visit This gave the children the opportunity to verify, clarify, and expand their knowledge and understanding of his collection. No one was able to identify the button hook and moustache cup. His description of the cutter and its uses has opened up a new area for investigation. Some children will return to ride in a horse-drawn sleigh this winter and,	The daily discussions of the discoveries the children have made in the various areas (reading, listening, etc.) have revealed a variety of new information and language. Price comparisons led to a discussion in economics and the changing value of money. The dress-up centre led to role-playing and informal drama. The reading materials in the reading centre produced much amusement and laughter.

since snow machines are used in this area, many comparisons and investigations can follow.

Choice Activities

Several youngsters have added the skill of playing a mouth organ and jew's harp to their repertoire, and the old victrola and records have elicited a number of new words to describe differences in sounds.

Attic Creatures

This teaching episode was teacher-directed to a greater extent than average because Robin's group experiences more difficulty in reading than the rest of the class. After reading the story and interpreting and reacting by creating pictures with captions (this involved much discussion and clarification of impressions), the information about our creatures was summarized and organized under specific headings.

The group made their own creatures with cotton wool and pipe cleaners (these materials were selected after much sorting, touching, and evaluating) and presented the information to the class. The presentation sparked the imagination of the whole class and many creative activities followed.

Imaginary creatures were created from a variety of materials. They have names and a special playground created by a group of boys.

Choice Activities

One group produced a song which the whole class sings often, using a number of musical instruments and actions to illustrate the ideas presented.

The class read an article entitled "Learning to Fly", which presented several problems in understanding words like spiral and flying by the mind's eye.

The gym period provided an excellent opportunity for the class to experiment with the movement of imaginary creatures. Their bodies expressed their understanding of words like spiral, bounce, slide, fly,

and float. Various groups created adventures in movement.

Individual children have expressed their ideas about their creatures in a variety of language forms. Their stories, poems, letters, and pictures have been discussed in small groups and are being read by all the children. One group of six children have been introduced to paragraphing and the use of quotation marks for direct narration. Christine's story, "The First Creature in the Stable", was used in this teaching episode (after Christine granted her permission).

The whole class created new information about their creatures. This information was analysed, discussed, and added to the original outline. All the information has been assembled and translated into a descriptive booklet. A parent volunteer has typed it. Various sections have been illustrated, and the book has been added to the school library.

Another group of four children created, played with, and manipulated a family of finger puppets. They taped their dialogues, which have become the basis of a script for a play entitled The Fuzz-Wuzz Who Visited Mars.

Choice Activities

Many new words, phrases, and expressions have been added to personal spelling and word lists. Several phonic and word games, used either on an assigned free-choice or a direct-teaching basis, have been added to the game centre.

Spelling, phonics, and word recognition skills have been dealt with each day, using the words that have grown from their experiences. Words like creature, porcelain, victrola, nickelodeon, cutter, antique, florin, wardrobe, have been added to each child's store of meanings and appear frequently in oral and written expression.

The migration headache that causes the attic creatures to move from their winter home in an attic to a junkyard has introduced the concept of seasonal changes and preparing for winter.

The class has developed a flow chart and has organized an outline for study. Interest groups are formed, their specific questions are recorded, and a variety of resources are made available to them.

One small group has visited a service station to discover what winterizing a car involves.

Six competent readers have embarked on an independent study. They are investigating the concepts of hibernation and migration and will share their information with the class.

Others are interviewing their parents and noting preparations people make for winter. A number of books and tapes prepared by older children are providing them with the information they need.

The activities in reading, writing, imagining, expressing, and responding will continue in and beyond the classroom. These children are growing into reading naturally. Their reading materials are varied, relevant, and enriching. They are read to regularly from books that are selected for their uplifting and enriching qualities. They have had many opportunities to write their own materials and read the thoughts and experiences of their peers. Reading grows out of their experiences and interests. Their classroom and school libraries feature the materials they have produced. They have experienced many fulfilling moments in their attempts to cope with print and have discovered that their total environment is filled with symbols they can read and understand.

SUPPORT DOCUMENT #7

FROM COUNTING TO CALCULATION

TABLE OF CONTENTS

FROM COUNTING TO CALCULATION

Introduction

The effectiveness of a school's Mathematics program has long been judged on the basis of tests purporting to measure basic skills in arithmetic. This situation resulted partly from the fact that facility in computation was regarded as a valuable asset in the job market, and thus a legitimate objective for education, and partly from the fact that arithmetic skills appear relatively easy to measure. Although these reasons for emphasizing basic arithmetic skills may not be as valid today, arithmetic is still an important component of the Mathematics program.

Numbers have more significance than ever before for virtually everyone and so it is important for children to learn how they are formed, how to operate with them, when to use them, and how to interpret the results. The ability to do arithmetic competently depends on the development of certain mental structures in the child. How and when these structures are established depends on the variety of the child's experiences as well as on his particular stage of development. This document describes concepts that are prerequisite for computation and then outlines some strategies for maintaining and extending the skills of calculation.

Counting

Counting is the process that answers the question "How many?" Many children come to school able to recite number names; teachers should not mistake this for the ability to count. In counting,words are used to record the number of objects in a collection, in the same way that notches on a stick or strokes on a clay tablet were used in ancient times.

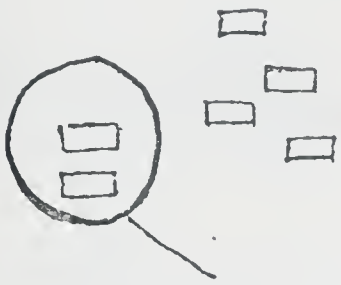
The child must learn the unique name of each number and be able to recall these names in a specific order; then he must apply these names in the correct order to the objects he is counting. Although the order of the number names is important, the child should understand that the assignment of particular names to particular objects is not. This point is illustrated by the following example.

A boy was counting six toy cars. He picked up each in turn saying, 'One, two, three, four, five, six.' Accidently two of the cars fell to the floor. Seeing this, his mother asked, 'How many cars do you have now?' The boy replied, 'One, two, five, six,' picking up each of the remaining cars in turn. The mother then said, 'You only have four cars, one, two, three, four.' The boy, quite upset, responded, 'Three and four are on the floor.'

In this example, even though the boy said the cardinal words "one, two, three, four, five, six", he has associated the ordinal idea of "first, second, third, fourth, fifth, and sixth"

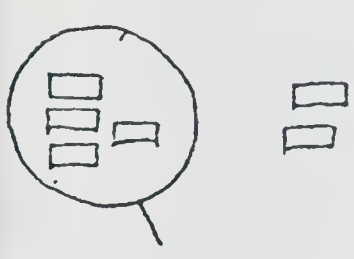
with the cars. He is correct in realizing that the third and fourth cars are missing, but has missed the collective aspect of counting. This example shows that the boy needs a number of experiences in which he can associate the counting numbers with sets of different sizes, as illustrated below.

one



two

three



four

five

six

Children often confuse the cardinal and ordinal aspects of numbers. It is important to provide experiences that enable them to discriminate between these two uses of numbers. Often the nature of the objects chosen contributes to the misunderstanding, as is the case in the following story.

The principal was asked to confirm a teacher's assessment that an eight-year-old girl needed special help with her counting. After preliminary discussion, the principal asked the girl to count the fingers on his hand. She responded by touching each finger in turn, saying, 'one, two, three, four, five.' The

principal then asked her to count his fingers in the other direction. The girl began 'one, two' and then stopped. Puzzled, she asked, 'How can it be both two and four?'

The idea of associating the four fingers collectively with the number name four had not yet been distinguished from the ordinal idea of associating the number name four with the fourth finger in the sequence. Obviously, this child needed many more experiences counting real things that are not as fixed in position as the fingers on a hand. Counting objects in a set naturally invites ordinal associations. The number names are applied to successive objects in the set until all the objects in the set are exhausted. Then the number applied to the last object (ordinal idea) in the set corresponds to the cardinal number of the set.

To understand numbers fully, children need both the idea of the number of things in a collection and the idea of the order or sequence of things. These two concepts could be developed in the following ways:

(i) children could be asked to build a "staircase" out of rods of progressively increasing size;

(ii) children could be asked to match the individual items of two sequences, both of which consist of objects of increasin size (e.g., dolls and walking sticks);

(iii) children could be asked to explain the concept that "six" is "one more" than "five".

Conservation of Number

Once a child can count the objects in a set without difficulty, it is important to find out if he understands the concept of conservation of number - that is, does he believe that the number remains the same regardless of the spatial arrangement of the objects? There are many ways to test this using two sets of objects of differing characteristics, such as coins and blocks.

Test of Conservation

Place 5 blocks and 7 coins on the table. Ask the child to match the blocks and coins.

Remove the surplus coins.

Question: Do you have the same number of pennies as you have blocks? -- or are there more pennies? -- or more blocks?

How do you know this?

If the child says that the two sets have the same number, change the arrangement by spreading out the blocks.

Question: Now, do you have the same number of pennies as you have blocks? -- or are there more pennies? -- or more blocks?

Why?

If the child's answer shows that he can conserve number at this level, it is suggested that he be tested again using 12 to 15 objects.

For further and more sophisticated tests of conservation, consult the references listed in the bibliography.

Notation

Some teachers expect children to recognize and write numerals early in their school experience. This may not always be a wise expectation as children often learn to use these symbols as labels without attaching real meaning to them.

Children need to pass through several levels of experience in learning to record numbers and use notation. First, they need many practical experiences to help them develop facility in counting and naming groups orally. From these situations they will develop their own system of notation for recording their ideas about numbers. This process begins with the experience of matching number names to objects such as pebbles or counters, is followed by the "tally" system, and culminates in making marks on paper to match the groups observed and regrouping these marks in twos, threes, fours, and fives. Finally, numerals and symbols for operations can be developed as the standard form through which people communicate ideas about numbers.

Children can usually "read" numerals before they can write them. This makes it all the more important for them to associate the written numerals with the verbal labels and with a variety of experiences in counting objects.

As soon as the child has a knowledge of the numbers from one to ten, he should be encouraged to use symbols to record this knowledge: $1 + 5 = 6$, $2 + 2 = 4$, $3 + 6 = 9$, $7 - 3 = 4$, and so on.

Practice in writing numerals has the same relationship to understanding number as copying the alphabet has to reading; both require practice.

Number Relationships

Counting real objects in a variety of situations enables children to discover many number relationships. For younger children these experiences should be limited to numbers up to 7. For some, the activity must be repeated over and over again before patterns emerge. Children must learn for themselves that it is not necessary to count on in ones to find that the sum of 4 and 2 is always 6. In fact, it is through the manipulation of concrete materials that it becomes obvious that $4 + 2$ and $2 + 4$ have the same sum. This discovery greatly reduces the number of addition facts to be memorized.

When the child has acquired an understanding of the numbers up to 7, he is ready to extend this study to 10 and beyond. It should be noted that these extensions do not require equal amounts of work or time to develop. Once the child has accepted the number system as a union of classification and ordering, the major difficulty with large numbers lies in the notation or, in this case, place value.

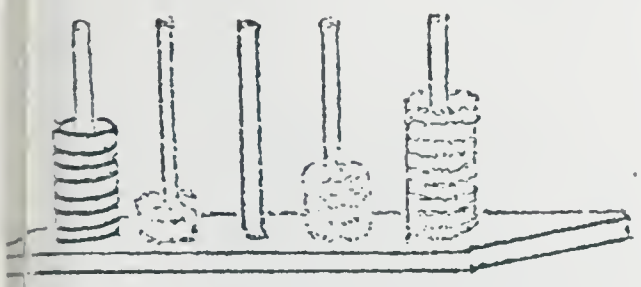
Place Value

Place value is one of the most important concepts related to counting and recording numbers. Effective teaching of this concept involves the use of manipulative materials (straws, discs, beads, or tongue depressors) to illustrate different groupings. However, the best analog of place value is to be found in cubes; their faces are congruent squares and so they can be fitted exactly on all sides.

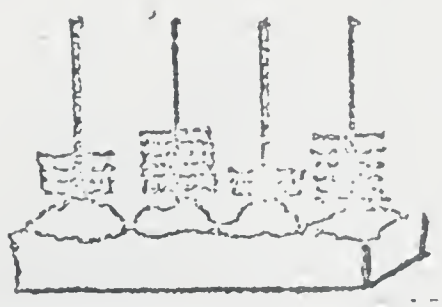
Dr. Zoltan Dienes has worked extensively with young children using his multibase arithmetic blocks to introduce numeration bases. Evidence collected over many years indicates that children of 7 or 8 years can use these blocks with ease to organize numbers in several different bases. This experience helps them to better understand the organizational pattern of our decimal system of notation.

The abacus is another useful device for the representation of numbers. It can easily be improvised from scrap materials such as bits of wire or wooden dowels and washers or rings.

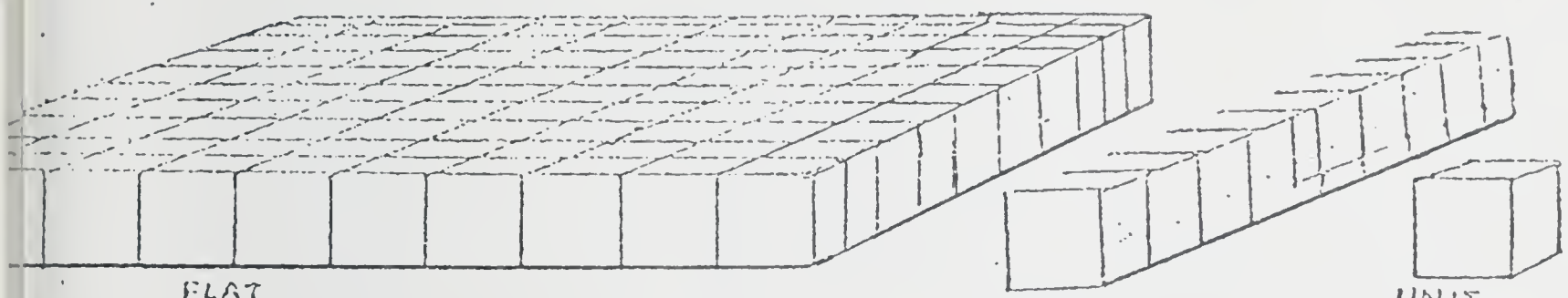
Children's ability to read and write numbers with both understanding and confidence depends on the variety of concrete forms in which they can represent the number system.



EL AND RING ABACUS



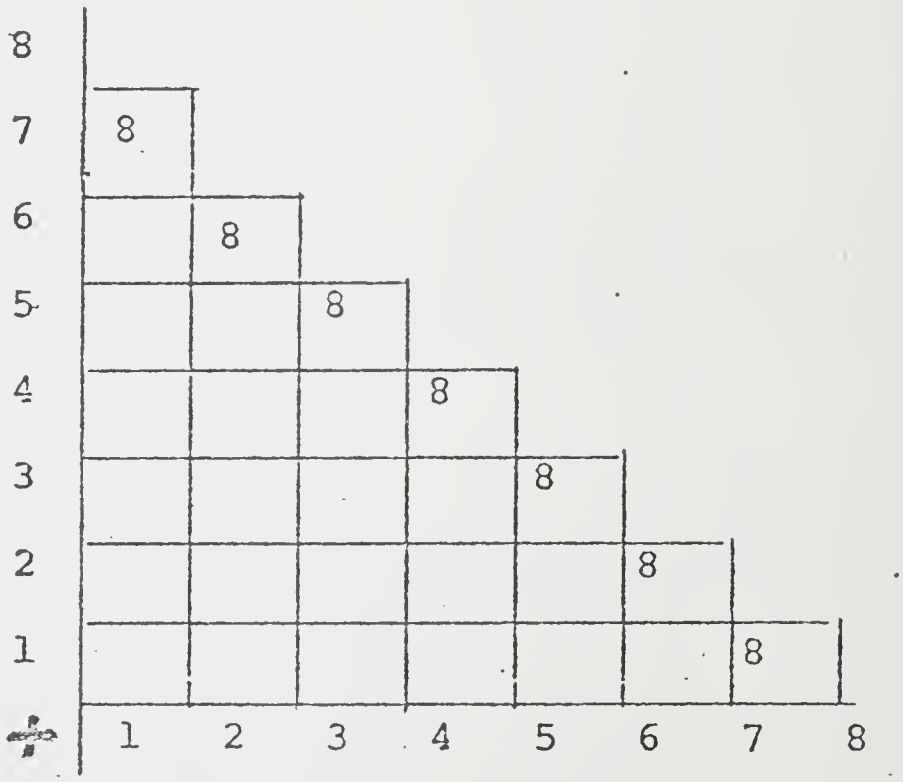
SPIKE ABACUS



DIENES' MULTIBASE BLOCKS

Structural Materials

As children begin to organize their knowledge of numbers, it is useful to introduce them to a variety of structural materials. The size, and in some cases the colour,of the materials is a useful aid in helping the child arrange the apparatus into meaningful patterns. For example, he can easily build for himself all the number relationships whose sum is 8 and record these on a chart such as the one given below.



The chart can be extended to 20 and used as a ready reference, if needed. This arrangement emphasizes many of the patterns that will help the child remember individual facts.

10	11	12	13	14	15	16	17	18	19	20
9	10	11	12	13	14	15	16	17	18	19
8	9	10	11	12	13	14	15	16	17	18
7	8	9	10	11	12	13	14	15	16	17
6	7	8	9	10	11	12	13	14	15	16
5	6	7	8	9	10	11	12	13	14	15
4	5	6	7	8	9	10	11	12	13	14
3	4	5	6	7	8	9	10	11	12	13
2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11
+	1	2	3	4	5	6	7	8	9	10

Basic Number Facts

Test

A good way to find out if a child knows the basic facts is to ask him orally. Brief, frequent quizzes enable the teacher to determine:

(i) whether each child is confident of his knowledge or whether he relies on 'counting on';

(ii) whether he understands that he can add numbers in any order (3 + 7 or 7 + 3) and whether he uses this to his advantage;

(iii) whether he recognizes and uses patterns that relate operations with 9 or 11 to operations with 10;

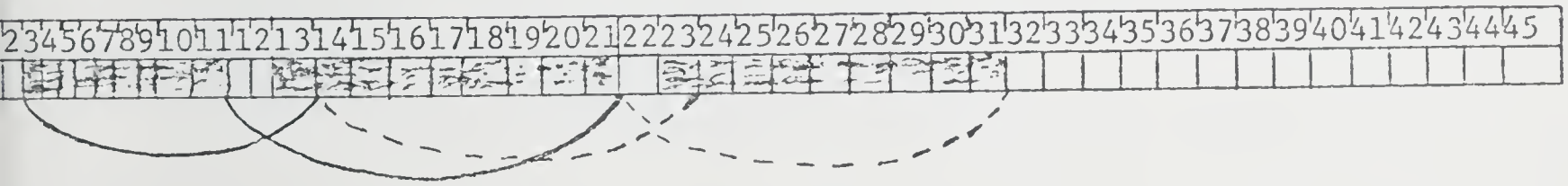
(iv) whether he uses estimation as a preliminary guide (e.g., 18 is 'near enough' to 20; 998 is 'near enough' to 1000) before working out the exact answer.

The extension of the child's knowledge of number relationships from 20 to 100 is a lengthy process. Again, it is useful to work through number patterns such as $8 + 7 = 15$, $18 + 7 = 25$, $28 + 7 = 35$, and so on; and $8 + 7 = 15$, $8 + 17 = 25$, $8 + 27 = 35$, and so on. These, along with those for $95 - 8 = 87$, $85 - 8 = 77$, $75 - 8 = 67$, and so on, need to be discovered by each child. Once these patterns are understood they need to be reinforced

through regular oral practice. There are also many interesting games that can be used either individually or in small groups to develop the child's competence and confidence. As with smaller numbers, a good way to find out whether children know facts about larger numbers is to ask individuals orally.

Number Line

A number line is a useful device to use at this stage. It can be made from graph paper or cash register tape. Fastened horizontally to the wall at a level within reach of the children, it should be at least 200 units long. The children can use coloured cardboard strips from 1 unit to 20 units in length to see number patterns such as 3 + 8, 13 + 8, 23 + 8, and so on.



Computation

Pages 124/5 of Education in the Primary and Junior Divisions outlines criteria for determining the readiness of each child for practice in written computation. It should be expected that the level of proficiency attainable by different children will vary widely. Thus care must be taken to choose activities that favour a reasonable expectation of success even though some children may have to use aids such as tables, number lines, and 'ready reckoners'. The inefficiency of these aids can provide the motivation for the children to memorize the facts they need most often.

The problems that emerge in the course of investigations involving real materials can lead quite naturally to written calculations. At first, the children should be encouraged to devise their own methods of working out the answer. These will probably be primitive, but through discussion within the group and questions from the teacher, the methods can soon be refined. The following anecdote illustrates this process.

A teacher of ten- to eleven-year-old children was just beginning to establish activity centres for problem-solving in mathematics. She had set up five centres with materials and activity cards that posed questions. One of these read, "Here is a bag of macaroni. Can you find out how many pieces the bag contains without counting the pieces individually?" The children were stymied for some time and their frustration began to mount.

The teacher, busy responding to requests from other groups, did not immediately notice the difficulty they were encountering. Passing near the table later, she reacted by picking up the nearest container, a half-size dixie cup, and placing it in front of the children with the question, "Will this help?"

The group immediately began to count the number of pieces needed to fill the dixie cup. They then proceeded to find out how many times they could fill the dixie cup from the bag of macaroni. One girl recorded the results using a tally system (𝍸 𝍸 ||, etc.). The final result was 40 cupfuls. One cup held 57 pieces. No one raised the question of whether the dixie cup was an appropriate unit.

Having found the number of times the unit was repeated and the number of pieces in the unit, the group were at a loss as to what to do next. Finally one ten-year-old requested permission to use the chalkboard. She proceeded to write until she had thirteen 57's in one column. She was half-way down a second column when the bell rang for recess.

57

57

57

.

.

.

While the children were outside, the teacher wrote ten multiplication questions on the chalkboard, including $\times \frac{57}{40}$. After recess, she asked the boys and girls to do the questions. Every child in the class got the correct answer to $\times \frac{57}{40}$, yet no one from the group doing the investigation with the macaroni realized that they had found the answer to their problem. For them, finding the answer to 57 x 40 was apparently a ritual that had nothing to do with the real situation of finding out how many pieces of macaroni were contained in the bag.

Every child needs to be proficient in each of the four operations; this requires practice. Decisions about the amount, frequency, and type of practice should be made jointly by the teacher and child. The enclosed cards provide sample activities that children have found enjoyable for maintaining and sharpening their computational skills. These cards should be supplemented with variations and extensions that will accommodate the wide range of interests found in the classroom.

Link Games

The following games - number snap, add-one, make a number and happy families - are all examples of link games. In these games players establish links between patterns of dots and the corresponding numerals. They are played with link cards, as described below.

Link Cards

Link cards comprise the following:

- a set of 40 numeral cards (each numeral from 1 to 10 is marked on 4 cards)
- a set of 40 pattern cards (each pattern is marked on 4 cards)


etc.

- a set of 40 unit cards marked with the numeral 1

Number Snap

Objective:

To associate a numeral and an equivalent number pattern.

Materials:

Link cards (numerals and patterns to six)

Number of Players:

To to six, and a dealer

Rules:

- Deal the numeral cards to the players (4 to 10 cards).
- Place the pattern cards face down in the centre of the table.
- The dealer turns over a pattern card.
- The first player to find the corresponding numeral in his hand says "snap". He matches the two cards and scores 1.
- If a player makes a mistake, he loses 1; the player who identifie the mistake scores 1.
- The process is repeated until a player goes out; he then becomes the dealer and a new round begins. The game continues for a specified time or number of rounds.
- The player with the highest score wins.

Variations:

- Extend numerals to ten, or beyond.
- Vary the number patterns, for example: 
- Change the scoring to correspond to the numeral in each "snap".
- Mix the pattern and numeral cards.
- Have the players make up new rules.

Add-One

Objective:

Given a whole number, to recognize the next larger whole number.

Materials:

Link cards (numeral and unit cards)

Number of Players:

Three to six, and a dealer

Rules:

- Deal each player a hand (4 to 10 cards).
- Place the stack of unit cards in the centre, face up.
- In response to the dealer's command "cards", each player puts a card face up in front of him.
- The first player to notice the next larger number to his own says "add-one"; for example, if his card is 4 and he sees a 5, he says "add-one", takes the 5 and a unit card, and builds the addition bond [4] [1] [5] in front of him. All the other players discard their unused cards.
- The first round continues until a player goes out; he then becomes the dealer and the game continues with a new round.
- Each bond scores one.

Variations:

- Use pattern cards, or both.
- Score by the sum of the bonds.
- Have the players make new rules.

Make A Number

Objective:

To identify two addends of a whole number. To identify two numbers whose difference is a given number.

Materials:

Link cards (numeral cards)

Number of Players:

Three to six, and a dealer

Rules:

- Deal each player a hand (4 to 10 cards) and place the rest of the deck in the centre, face down.
- On the command "card", each player places a card in front of him, face up; then the dealer turns over a card.
- The first player to build an addition or subtraction bond equal to the dealer's card, by using a second card from his own hand or from one of the other cards on the table, says "make a number". Example: The dealer turns up a 5, player C uses his own 3 with a 2 from player A to build a 3 2 equal to 5.
- Each bond scores 1.
- The first round continues until a player goes out; he then becomes the dealer and the game continues with a new round.

Variations:

- Use only pattern cards, or both numeral and pattern cards.
- Permit addition only and use any three exposed cards to make a bond.
- Permit subtraction only and use any three exposed cards to make a bond.
- Award a bonus to the player who goes out in each round.
- Have the players make new rules.

Happy Families

Objective:

To recognize the missing addend of a sum.

Materials:

Link cards (numerals, possibly extended to 20)

Number of Players:

Three to six

Rules:

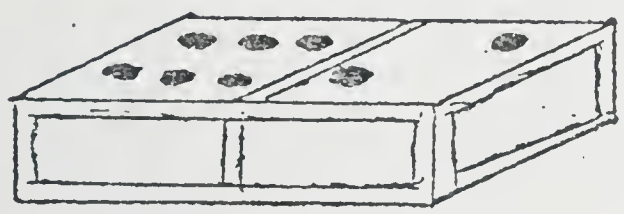
- Player A deals each player (including himself) a hand (4 to 10 cards).
- Player A places a card from his hand (say 3) on the table and decides on another larger number (say 11). He says, "I want a number to go with my 3 to make 11." Player D answers first, saying, "Here is an 8 to go with your 3 to make 11." Player D scores 1.
- Player D continues, placing a card (say 5) on the table. He says, "I want a number to go with 5 to make 9."
- The game continues until one player goes out.

Variations:

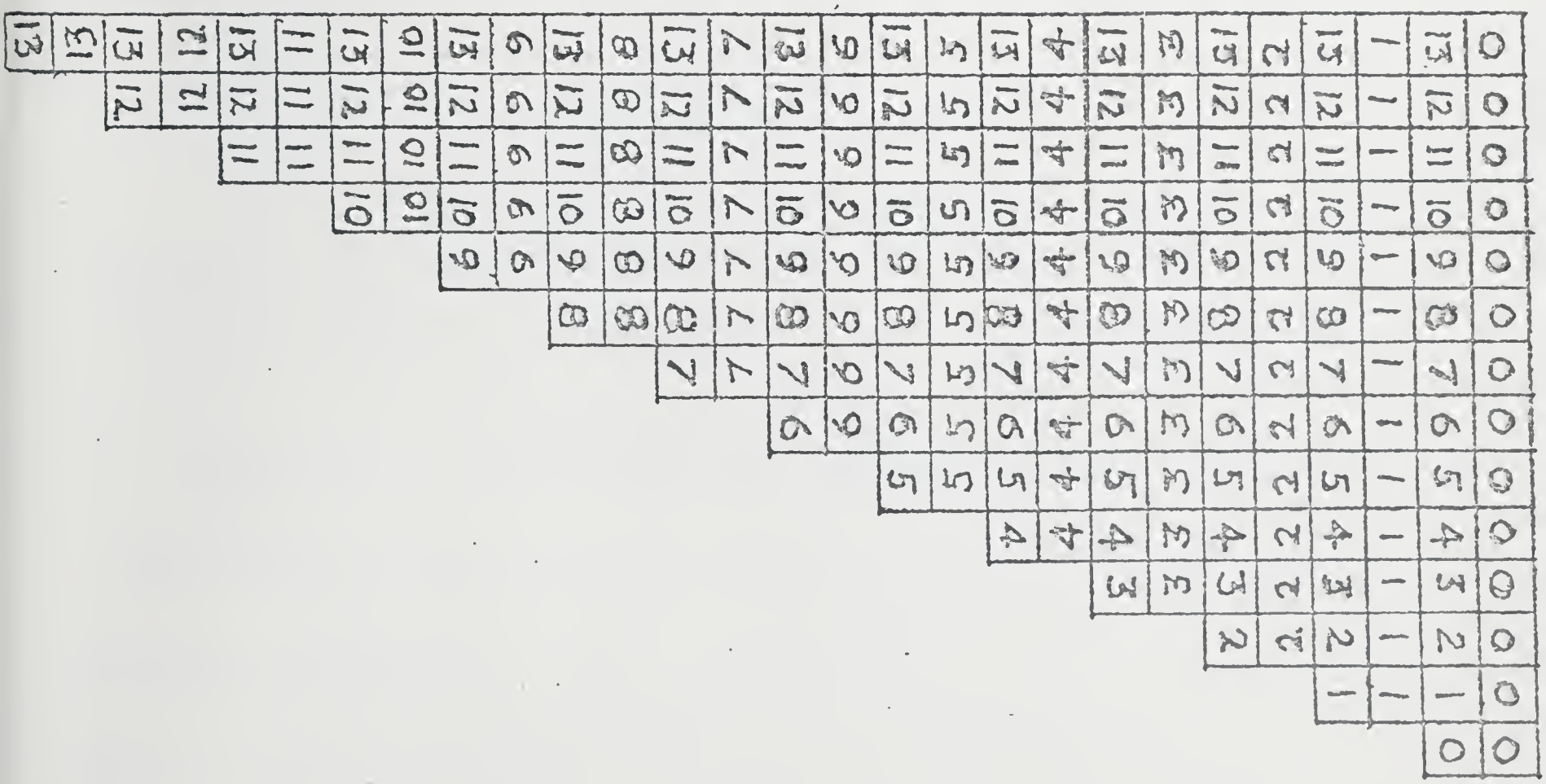
- Use subtraction instead of addition.
- Use only pattern cards, or both numeral and pattern cards.

Dominoes

This game can be modified in many ways to provide relevant experiences for children at different stages of growth. Small dominoes of commercial sets are often difficult to handle for young children; for this reason, as well as to introduce numerals, it is useful to make your own dominoes, using 1" x 2" pine or spruce cut into 4" lengths and sanded smooth. When labelled and varnished, they are more attractive and durable.



Use dots to label one set and numerals for the other. A pattern for enlarging the sequence of dominoes is given below:



The number of dominoes used and the rules of the game can be adjusted for specific purposes. The following are examples of a few of the many possibilities.

Game 1

Objective:

To recognize equivalent number patterns from zero to thirteen.

Materials:

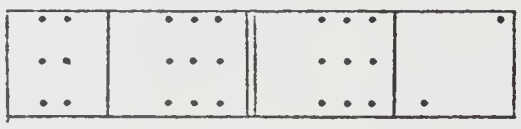
Pattern dominoes

Number of Players:

Two to four

Rules:

- Place all the dominoes face down on the table. Each player chooses the same number of dominoes. These are placed on edge in front of each player so that the labels are visible only to him.
- The player with the largest pair, such as  places his domino face up in the centre of the table.
- The player on his left then places a domino with a matching number of dots on either end of the first domino, as shown:



- The next player plays a domino that will match either the  or the  If he does not have one in his possession that matches either of these, he draws a domino from the 'bank'.

- If the domino drawn is not playable, he loses his turn.
- The player who succeeds in getting rid of all his dominoes first is the winner.

Game 2

Objective:

To recognize equivalent numerals and number patterns.

Materials:

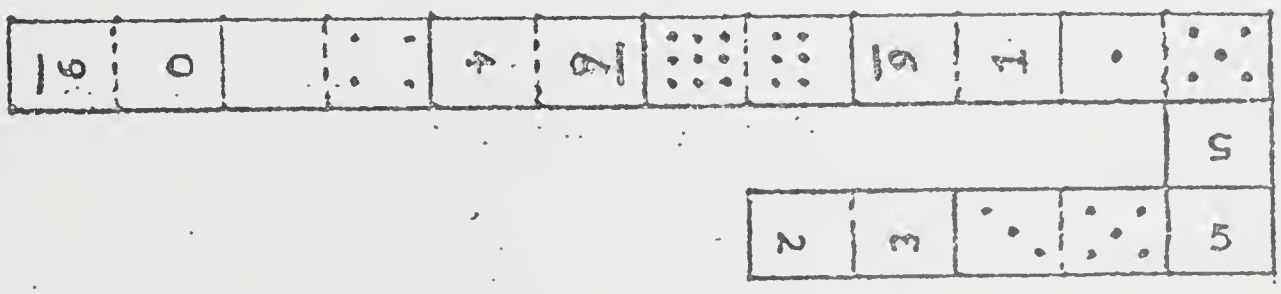
Pattern dominoes and numeral dominoes

Number of Players:

Two to four

Rules:

- Similar to Game 1, except that player 1 chooses a domino with numerals, player 2 selects a domino with dot patterns, etc.
- The challenge is to match the number of dots on one domino with the correct numeral and vice versa.



- The winner is the player who succeeds in playing all his tiles first.

Game 3

Objective:

To recognize equivalent numerals and number patterns; to recognize addends of a given number.

Materials:

Pattern dominoes and/or numeral dominoes

Number of Players:

Two to four

Rules:

- The procedure is the same as for Game 1, except that tiles may only be added if the sum of the symbols on the joining halves is ten (or some other number chosen by the children or the teacher).
- This time the zero or blank domino can be treated as 'wild' or 'free' - i.e., it assumes any value the child chooses.
- Again, the first player to use all his tiles is the winner.

Variations:

- The numerals used as labels can represent larger numbers such as 12, 13, 14, etc.
- Further challenges can be imposed by restricting sums to either odd or even numbers.

Game 4

Objective:

To identify number pairs with a fixed difference.

Materials:

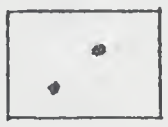
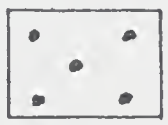
Pattern and/or numeral dominoes

Number of Players:

Two to four

Rules:

- The procedure is the same as in Game 1.
- The criterion for playing a domino is that the difference between the domino being played and the one on the table must be 3 (or some other pre-selected number). For example: if the domino is  , the player must choose

 or  to play on  ,

or

 or  to play on 

- Again, the object of the game is for each player to make plays that cause the opponents the most difficulty while disposing of his own tiles as quickly as possible.

Behind the Story

A. Once in a while it is useful to make up situations or stories to fit computational exercises.

Take number sentences such as: $5 + 4 = 9$ $4 + 5 = 9$ $9 - 5 = 4$

Make up a story to show how these number sentences might have originated. For instance: I read five pages in my book this morning and four more this afternoon; I have read nine pages today. Jean read four this morning and five this afternoon; she also read nine pages. George has read five pages up to now; he must read four more to catch up.

B. Simple problems can easily be made more challenging by altering some of the conditions.

Mary wanted to buy a pencil and an eraser. She knew that the pencil cost 15¢ and the eraser 10¢. She had three dimes in her purse. When she arrived at the store she saw this sign.

SALE		
Pencils	Reg. 15¢	Now 12¢
Erasers	Reg. 10¢	Now 7¢
No more than 3 of each to a customer		

- How much will Mary save?
- Could she buy two pencils and one eraser with her 30¢? What about one pencil and two erasers?

- If she had one dollar to spend, what is the largest purchase she could make? How much change would she get? What is the smallest possible purchase?
- How many different purchases could be made at this store with the limitation that has been put on this sale? We already know the largest and the smallest. How many are in between? How much would each of these purchases cost?
- The largest would be 57¢. What would the next largest be? Could there be a purchase of 54¢?
- Mary's friend, Dorothy, spent 24¢. What did she buy? Can you be sure that it was two pencils?
- Peter heard about the sale. When he gave the cashier 50¢, he received 5¢ in change. What did Peter buy?
- The cashier had made a 'work saver' chart that looked like this:

Number of pencils @ 12¢

Number of erasers @ 7¢	0	1	2	3
0				
1				
2				
3				

Complete the chart. (Look for short cuts.)

- Make up a chart using the regular prices for the pencils and erasers.

C. Similar problems can be developed using advertisements from newspapers and sale catalogues. These can be varied in difficulty by using fractional or per-cent reductions and changing the restrictions on the quantities allowed each customer.

Shopping Spree

Have the children cut out pictures of groceries, clothing, toys, and other products from an old catalogue. Make a "store" booklet by pasting these on the pages and showing the prices of the articles. (Simplify, if necessary.)

(i) Problem

Ask each child to make up a shopping list and exchange it with a partner. Each child "shops" and calculates his expenditure.

(ii) Problem

Prepare a supply of 'play-money'. Each child draws a ticket that tells him how much money he has to spend. He obtains the play-money from the bank, simulates the shopping, pays for his purchases, and calculates the change due to him.

(iii) Problem

Each child draws a ticket stating how much money he has to spend. He is to decide how many and what variety of articles he can afford to buy with this sum.

The computation in these problems can be varied in difficulty by:

(a) varying the number of articles to be bought, from two upward (e.g., 2 cubes at 10¢);

(b) varying the complexity of the prices, from 10¢ or 15¢ or 25¢ for each item (e.g., 10¢ and 15¢ (mixed prices); 10¢ and 15¢ and 25¢ (mixed prices); $1.50, $1.25, $1.15 (mixed prices); $1.48, $1.22, $1.16 (mixed prices).

Roll the Dice

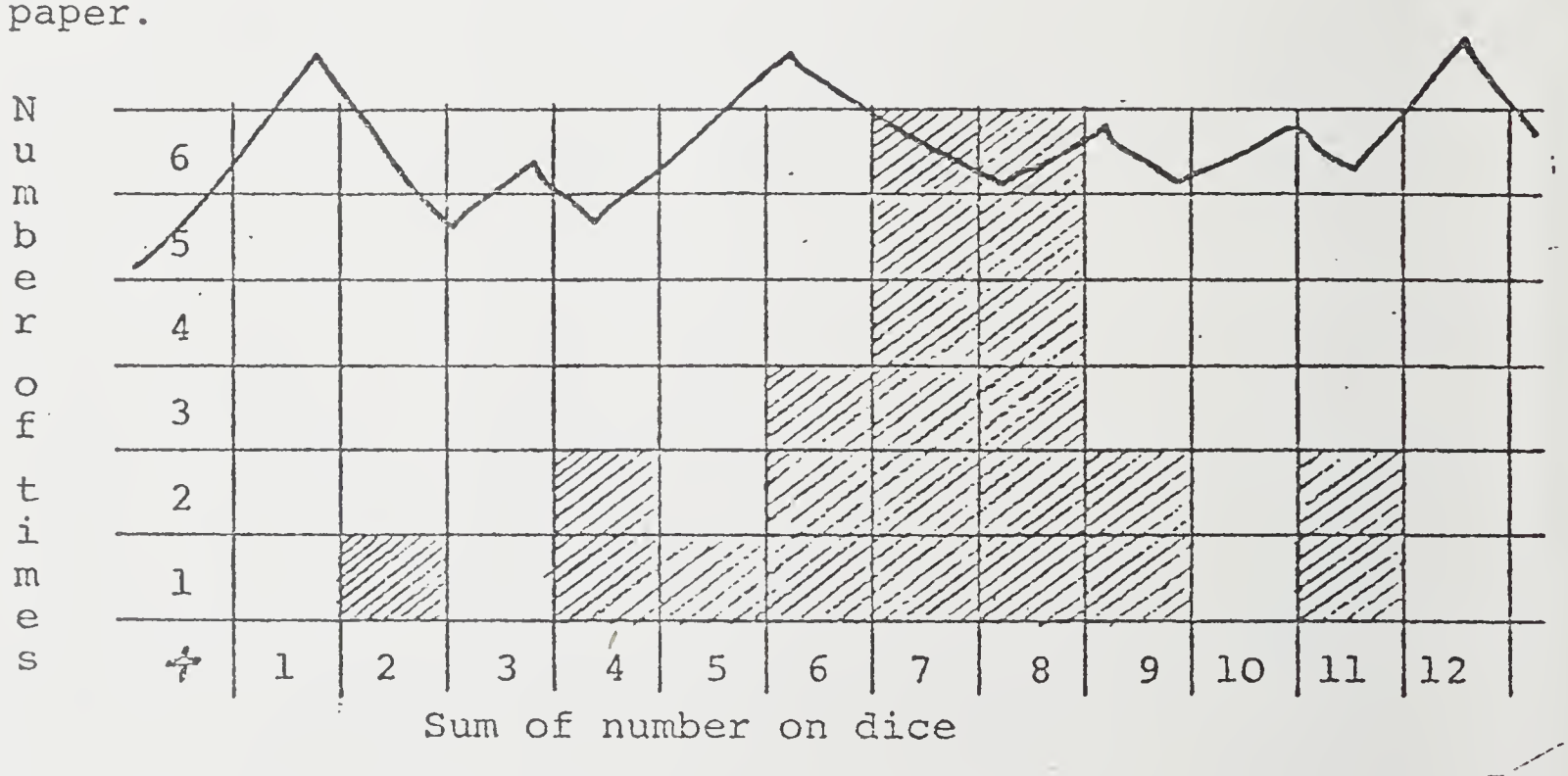
Materials

Squared paper and dice - The dice may be purchased commercially or made from wood or plastic cubes of suitable size. Either dots or numerals can be used as labels.

Method

Working in pairs or in small groups, the children decide on an operation to be applied to the pair of numbers. For example: 3 + 2 or 3 - 2 or 3 x 2.

Roll the dice 100 times and record the scores on the squared paper.



- Which sum or sums occur more frequently?
- Which occur least often?
- Compare your results with those of your classmates.

The teacher can supply the squared paper with the baseline and the columns already numbered if the children need this kind of help. Later on they can find out for themselves how many columns are needed.

Variations

1. Change the numerals on the faces of each die. For example, the faces on one die could be labelled 2, 4, 6, 8, 10, 12, and the faces on the other 1, 3, 5, 7, 9, 11. Taking turns, roll the dice 100 times and record the results on a graph. Compare your results with those in the first game. Which sum or sums occur most often? Which occur least often? What do you notice about the sums?

There are many possibilities for labelling, such as multiples of 3, 5, or 10, square numbers, prime numbers, and others.

2. Use two dice, using 0 in the place of the 6. Ask the children to predict what will happen when:

- you add 0
- you multiply using 0

Repeat the 100 rolls, record the results on squared paper, compare this graph with your first graph. Which sum occurs most frequently? Which occurs least often?

3. Use three different dice with various combinations of numerals. The operation may be addition, subtraction, multiplication, or a combination of these. For example: using red, blue, and green cubes, add the numbers appearing on the red and blue dice and subtract the number on the green. Taking turns, roll the dice 100 times and record the results by means of a graph. This activity not only provides practice in recalling basic facts but gives experience with the order of operations. Children should be encouraged to predict the most frequent and least frequent results and to give reasons for their predictions.

From Fragments to Patterns

The examples below illustrate conventional forms of writing addition exercises:

a)

4	3	4	4	5	3	6	3	5	5	6	6
+3	+6	+5	+6	+3	+4	+4	+5	+6	+4	+3	+5
7	9	9	10								

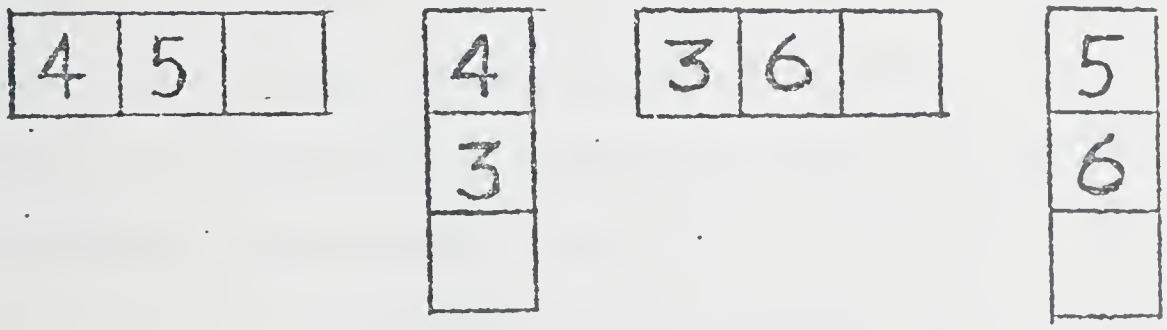
b) 4 + 3 = 7 6 + 3 = 9 5 + 4 = 9, etc.

Although children should be able to do such exercises efficiently, these forms do not help them to see patterns that substantially reduce the number of facts to be memorized, nor do they reinforce understanding of number properties.

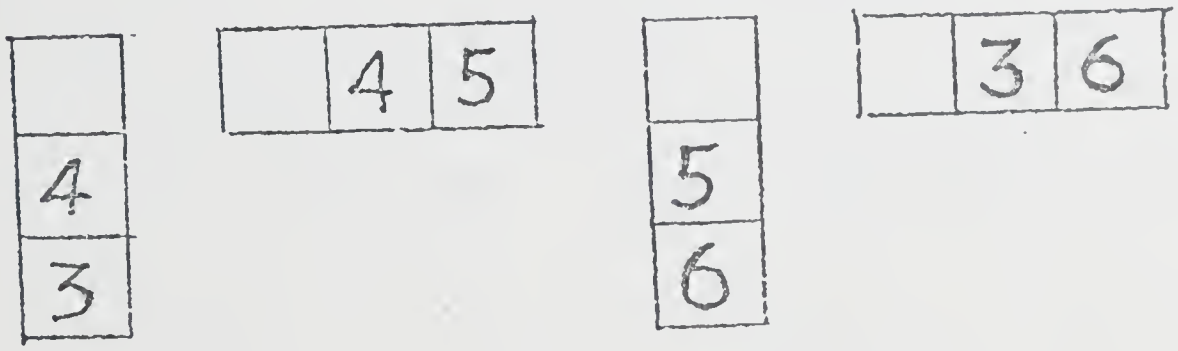
The following sequence of exercises represents one method of improving the child's addition skills while stimulating his curiosity and increasing his enjoyment.

1. Add the given numbers. Place the sum in the empty square.

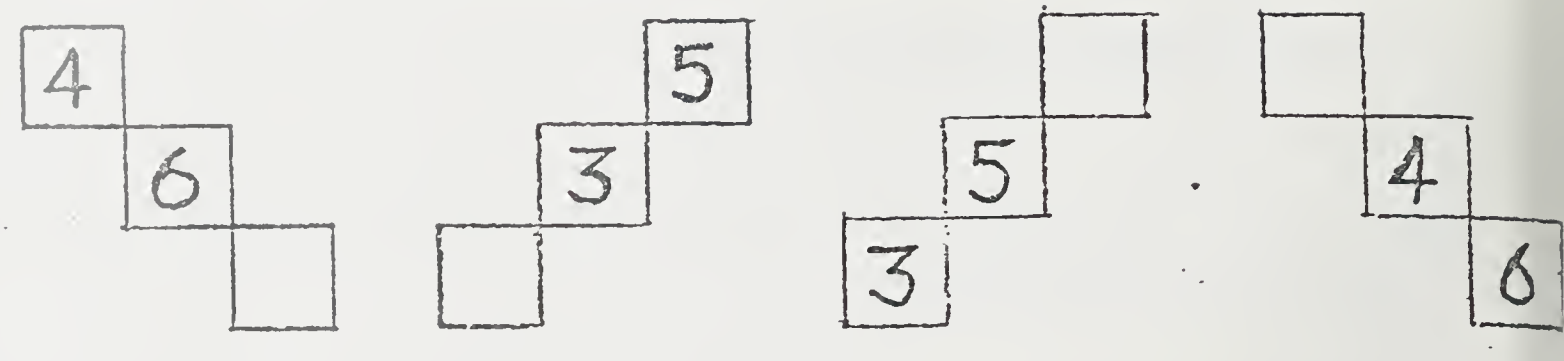
(a)



(b)



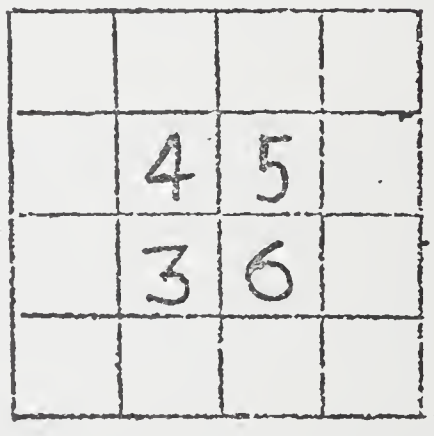
(c)



Notice that these examples cover the same 12 number facts as the conventional exercises above.

2. In the example below the same number facts are compressed into a 4 x 4 box.

Fill in the empty squares by adding horizontally, vertically, and diagonally.

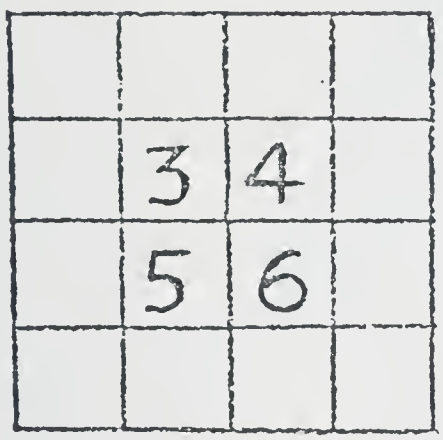


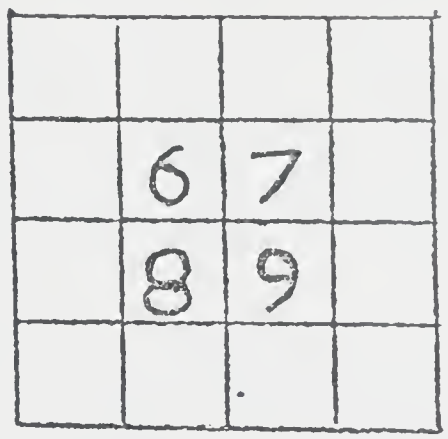
The completed form takes up little space, uses the 'puzzle' format to stimulate interest, and, when completed, offers the satisfaction of accomplishment. It is also a compelling demonstration that order does not make any difference in determining the sum of two numbers.

There is much to learn from this form. The discussion could begin with "Do you see anything in this structure worth talking about?" Responses will include such statements as, "The opposite corners are alike ... The middle two pairs at the top

and the bottom are the same...The middle pairs on the vertical sides are alike." Perhaps someone will notice that the sums are from the sequence 7, 8, 9, 10, 11.

The question "Is this a special case, or will patterns like this one occur again?" leads to further experiments with different arrangements of the same numbers and with different numbers in the central four squares, as illustrated below.





There are many obvious similarities. A new pattern was created when the arrangement was changed, namely, the numbers in all four corners are the same. Using different numbers, the sum of the 'middle pairs' is 30.

The class is now ready for individual activity. The children will want to try their own versions. Some may want to try bigger numbers, others may wonder what happens if zero is included in one or more of the central squares. Do the numbers have to be in sequence to make the numbers in all four corners the same? Can you find new patterns? Can you find examples that are without pattern?

There are some ingeniously organized arrays of numbers which have interested mathematicians and fascinated children of all ages for thousands of years. They are called 'magic numbers' because the sums of every row, every column, and both diagonals are equal. The following are examples of 3 x 3 and 4 x 4 magic squares.

(a)

6	1	8
7	5	3
2	9	4

(b)

13	2	3	16
8	11	10	5
12	7	6	9
1	14	15	4

(c)

1	10	9	14
13	10	5	6
8	3	16	7
12	11	4	7

A standard magic square uses consecutive natural numbers starting with 1. Example (a) is a standard magic square of the third "order", (b) is standard and of the fourth "order", (c) is a non-standard magic square of the fourth "order".

Once a magic square has been constructed, more magic squares can be made from it by adding, subtracting, multiplying, or dividing every number in the square by the same number.

11	6	13
12	10	8
7	14	9

+5

$1\frac{1}{2}$	$\frac{1}{4}$	2
$1\frac{3}{4}$	$1\frac{1}{4}$	$\frac{3}{4}$
$\frac{1}{2}$	$2\frac{1}{4}$	1

÷4 ⇐

6	1	8
7	5	3
2	9	4

⇒ -1

5	0	7
6	4	2
1	8	3

×2

12	2	16
14	10	6
4	18	8

Other variations can be made by reflecting the square either on the vertical or horizontal axis or by rotating it.

4	9	2
3	5	7
8	1	6

Rotate half turn about the centre of the square

4	3	8
9	5	1
2	7	6

Reflect in diagonal

6	1	6
7	5	3
2	9	4

Reflect in vertical axis

8	1	6
3	5	7
4	9	2

Rotate quarter turn clockwise about the centre of the square

2	7	6
9	5	1
4	3	8

Find other variations.

At the beginning, the children will be interested in testing the squares to see if they are indeed magic. Later they will be able to fill in missing numbers in magic squares, provided that at least four numbers are given, three of them in a straight line. Another way is to locate three numbers, two of which must be in a straight line, and provide the sum of one row, column, or diagonal.

4		
3	5	7

11		
12		
		9

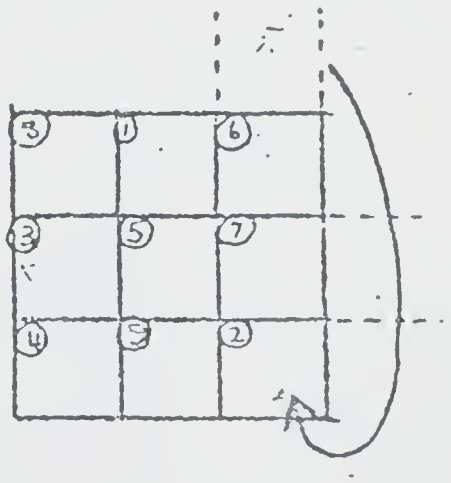
Sum=30

Finally, some children may wish to make their own magic squares, either by trial and error or by following this procedure:

1. Write the numeral 1 in the middle unit of the top row.

2. Move right one and up one. This position is above the third column; enter the 2 in the bottom square of the third column.

3. Move right one and up one. This position is to the right of the second row; enter the numeral 3 in the left square of the second row.



4. Move right one and up one. This square is filled; enter the 4 in the square below 3.

5. Move right one and up one; enter the numeral 5 in this square.

6. Continue the pattern of steps 2 to 5 until all the squares have been labelled.

7. Use this order to enter any sequence of numbers that you choose. For example: 3, 6, 9, 12, 15, 18, 21, 24, 27.

This pattern can be extended to squares of order 5 and 7. It will not work for magic squares of order 4 or 6.

MAPS AND GRAPHS

SUPPORT DOCUMENT #8

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MAPS AND GRAPHS

In many classrooms children are actively learning mathematics in groups by investigating situations related to their environment. Sometimes these activities take place out-of-doors in connection with field trips and special projects; at other times they involve the investigation and discussion of objects and ideas that children have brought from their homes and communities. Most often, though, the investigations are a part of the regular classroom routine (e.g. research projects, activity cards) and involve the use of commercial and locally constructed material. Whatever the mode of investigation, the children need a relaxed atmosphere in which they can explore and discuss their findings freely, using their own language as well as other means of communication. The role of the teacher is that of a catalyst -- providing encouragement, asking questions, making suggestions, and injecting new ideas or materials to keep the investigations moving along.

Investigations expand children's awareness of their environment, stimulate their creativity, encourage original thinking and the growth of spatial perceptions, and help build confidence in their ability to find out things for themselves. However, the investigations should not be considered as ends in themselves, but rather as vehicles for learning the mathematics that is imbedded within them.

Mathematics enables children to develop a fuller understanding of the world about them, both qualitatively and quantitatively. The investigations provide a framework in which their current mathematical knowledge can be reinforced and from which new mathematical ideas can grow. Teachers

should consciously build on this experimental base when introducing new ideas into the program; in fact, these ideas should be the basis for planning activities in the first place. Without inhibiting open-ended exploration, the teacher should ensure that each investigation contributes to the achievement of some objective of the mathematics program. It is through such purposeful planning that children begin to view mathematics as a coherent whole rather than a collection of isolated facts.

Why Maps and Graphs?

One of the broad aims of a program based on investigations is to encourage children to talk to one another about their findings. Left on their own, they will search for ways of communicating, using their own language and various forms of visual presentation (e.g. real objects, pictures). These forms of communication reflect the children's creative abilities and should be encouraged; they are the children's early attempts to use simple notions of maps and graphs. Over a number of years, teachers should gradually introduce the children to basic uses of maps and graphs for recording and communicating their findings. The accumulation of skills for making, interpreting, and analyzing maps and graphs extends over the entire elementary and secondary program, and beyond. The ideas introduced at this level should be simple and should not go beyond the children's natural ability to express themselves through pictures and models.

The pages that follow identify simple forms of presentation suitable for children in the Primary and Junior Divisions. Initially these involve the use of real objects, pictures, and then simple mathematical graphs. These early experiences with representation evolve into more sophisticated uses of graphs and maps in later years.

Beginning Maps and Graphs

Maps and graphs have their roots in the fanciful play of young children. The models they build with blocks, boxes, and other objects, as well as their toys, are miniature representations of the world as they see it. In moving these objects and positioning them in relation to one another, the children are developing and improving their spatial perceptions. On the one hand, their conviction that these models are the things they represent shows their readiness at this early age to use physical objects to create levels of abstraction; on the other hand, for children, these models are as real as the things they represent. As they build these models and pictures and play with them, children often talk to themselves and to others, revealing their basic feeling that these representations are interwoven with reality.

These processes of representation are evident early in the life of young children, particularly between the

ages of four and seven. They can be recognized and encouraged through the following activities:

- imitative gestures (symbolizing through action something not present);
- imitative performance (house and role play);
- symbolic play (objects and situations are adapted by the child's imagination, fostering creativity and problem-solving instincts);
- play with miniature models (dolls and model cars);
- making models of reality (building and furnishing a playhouse);
- drawing pictures;
- talking about things.

The making, interpretation, and understanding of maps and graphs depend on a variety of early experiences with positioning, perceiving direction, and orientation. These experiences need to be complemented by activities involving observation, classifying, sketching, and representing by symbols and by a fundamental grasp of counting, measurement, co-ordinates, scale, and proportion. A working familiarity with these concepts and skills grows out of the recording and reporting of the children's investigations, and is nurtured by the

careful planning and support of the teacher who arranges a developmental inter-play of simple ideas of maps and graphs with the other concepts and skills of the program. With this kind of background, the making of maps and graphs and their interpretation can become a significant part of the program, extending beyond copying or reading information from them.

Mapping Related to Maps and Graphs

The process of map-making is not to be confused with the concept of mapping, which at this stage simply involves the use of arrows to show the correspondence of the objects of a given set to the objects in a second set. This correspondence may be one-to-one (as in figure 1) or many-to-one (as in figures 2 and 3). With young children mappings are used to represent situations drawn from their every-day experiences.

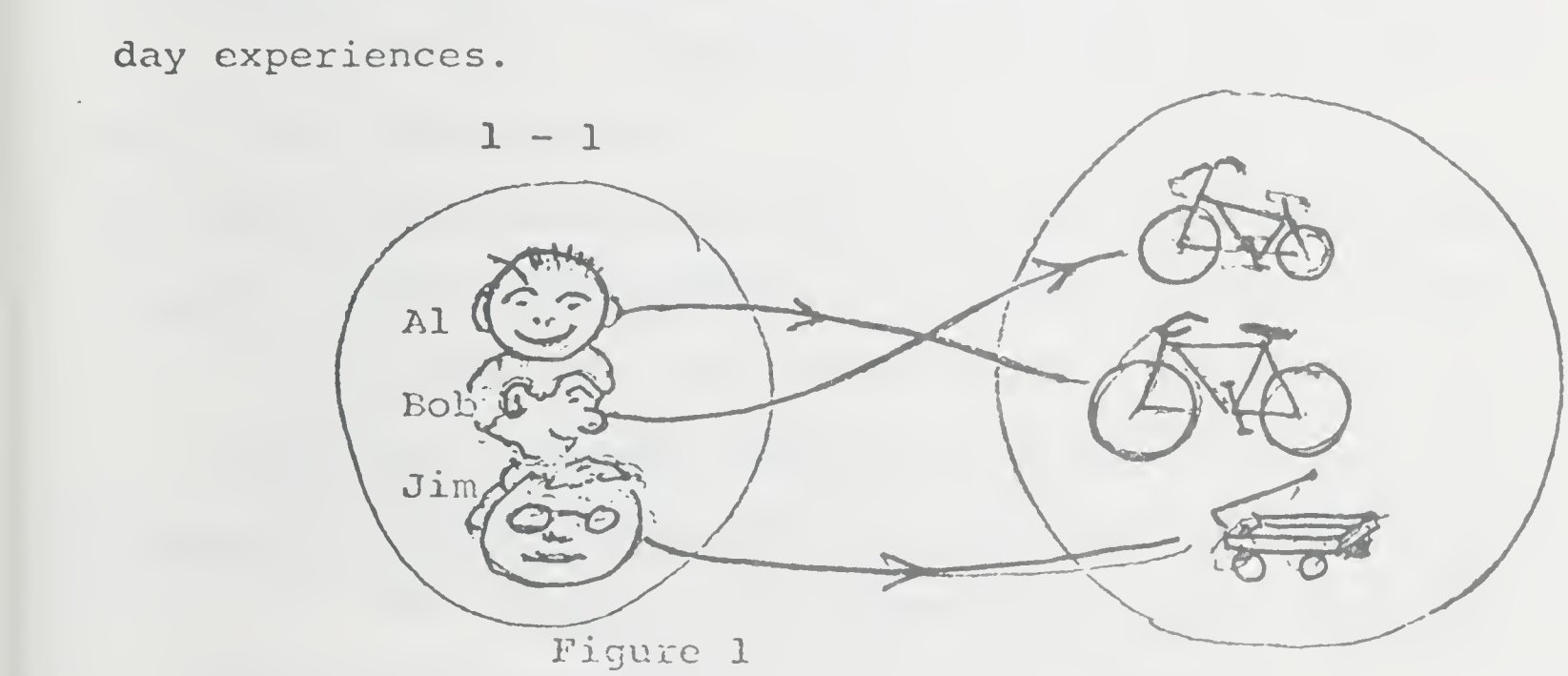


Figure 1

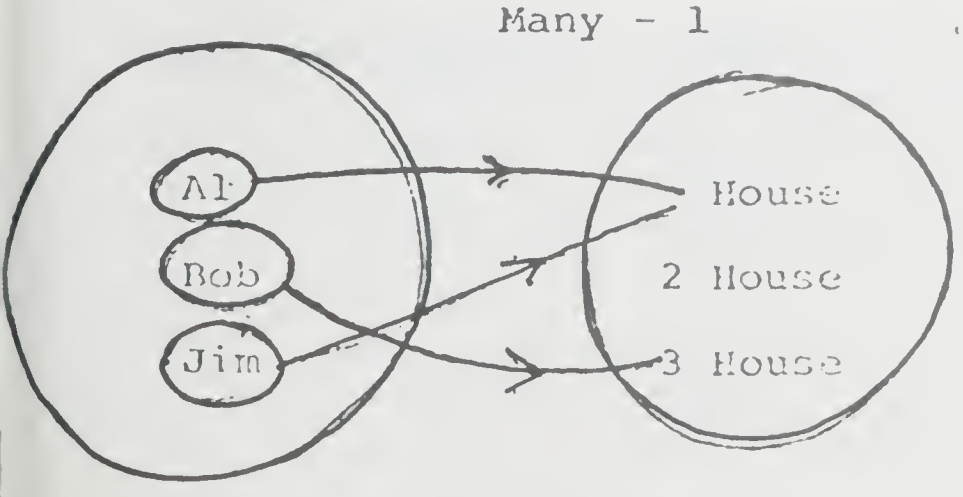


Figure 2

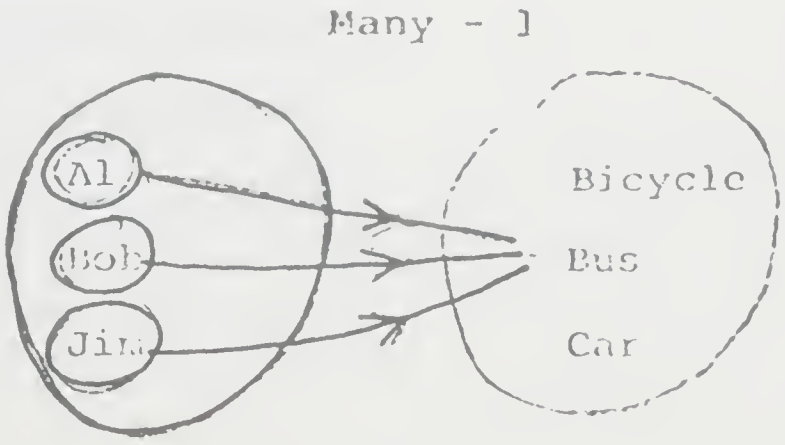


Figure 3

Mapping arrows are also used to show correspondence between a figure and its scaled or distorted image, as in figure 4.

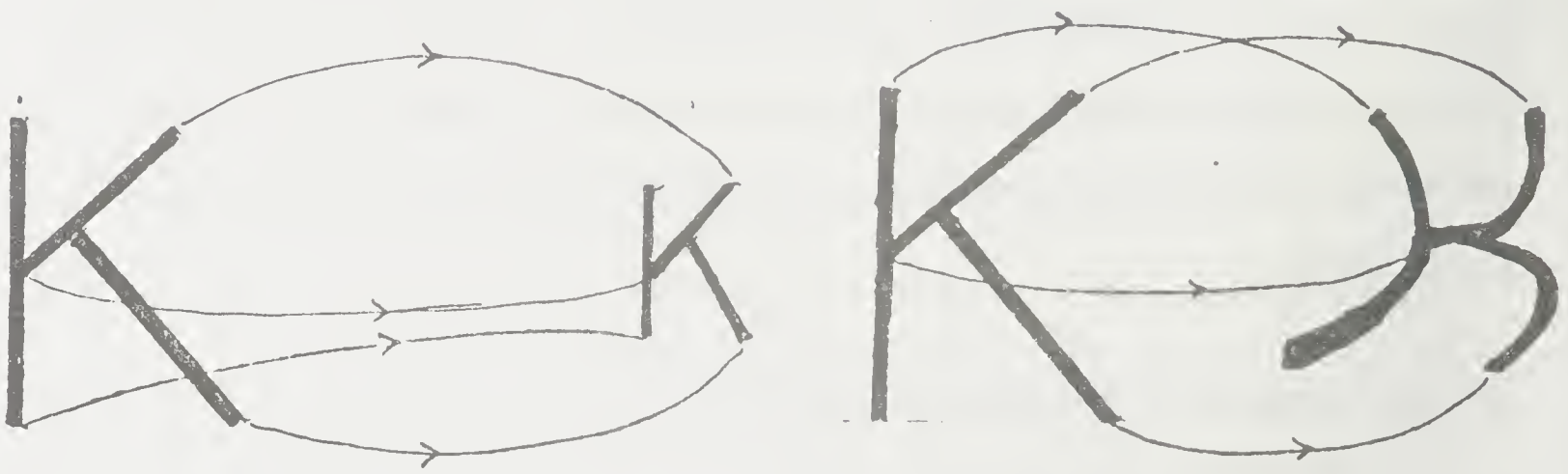


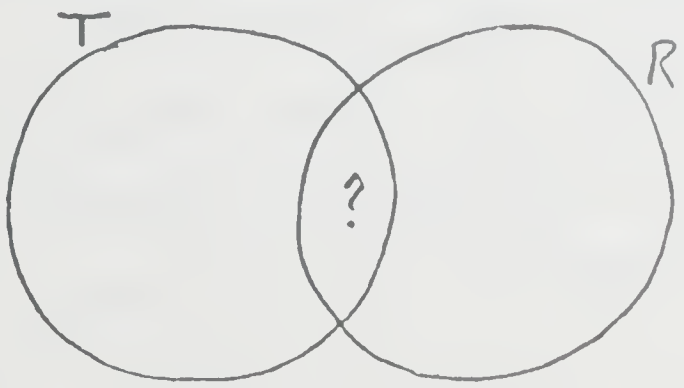
Figure 4

In elementary map-making, the principles of 1-1, many-1, scale, and sometimes distortion mappings are used, without being specifically identified. For example, the drawing a child makes on the page is usually a many-1 mapping of a 3-D object onto the 2-D picture.

Although young children are not ready for the formal mathematics of mappings, they do find arrows natural and easy to use in showing the correspondence of the objects in one set to those in a second. A variety of experiences related to mappings prepares the child conceptually for early as well as later work with maps and graphs. These experiences may include:

- building models to represent real situations (farmyard, train, house);
- making diagrams and sketches to represent real situations in which approximate positions, directions, and orientations are shown;

- showing relations between sets of real things (hockey players and their teams, children and their homes, learning materials and their storage places);
- finding correspondence of names with heights, with masses (weights), with hair colour;
- showing the relation of points in a projectual master and the image points on a screen (scale projection or distortion, relative distances);
- estimating distances and orientation;
- investigating shadow images (length, direction);
- examining real objects and their images in mirrors (flat, round, hollow, cylindrical, irregular);
- experimenting with slides, turns, flips, using materials such as geoboards, dot paper, tracings, and mirrors;
- investigating symmetries (line-, turn-, slide-, and point-symmetry in pictures; plane-, turn-, slide-, and point-symmetry of 3-D objects);
- making scale drawings and distortions;
- finding number patterns (based on operations, "what's the rule" games when given input and output values);
- using Venn diagrams to classify objects and numbers by their attributes.



T: set of triangles

R: set of red things

?:

Developing Map-Making Skills

The following is a suggested sequence of activities that will help children develop the concepts and skills required for map-making. The activities have not been assigned to particular age or grade levels because each child's ability to comprehend ideas connected with this form of representation depends on the kinds and amount of experience he has had at home and at school. An attempt has been made in the ordering of activities to reflect current knowledge of the growth patterns of children.

The association of activity and language in these situations extends the child's vocabulary in an incidental yet meaningful way. Comparison words, such as same, similar, taller, thinner, heavier; scale words and phrases such as bigger, smaller, twice as long as; direction words such as up, down, left, right, north, east; position words and phrases such as second desk, table under the window, third chair in the fifth row; attribute words such as purple, red, square, triangular, soft, rigid; as well as number words are in constant use as the children work together collecting, organizing, and recording information through models, pictures, and maps.

Sand table activities

Children arrange objects to make 3-D models of reality such as a farm, a room at home, a local park. (Observation will reveal the child's understanding of enclosure, levels, and conditions of membership in a set.)

Model-making

Children use scrap pieces of wood, fabric, paper boxes, blocks, clay, and other materials to represent houses, streets, machines, pets. (Scaling will not be precise; rough proportioning usually reveals the child's perception of what is most significant to him at the time.)

Picture-making

Children record events and perceptions of the environment using a variety of materials such as paint, crayons, finger paint, scraps of fabric and coloured paper, as well as small objects. (These usually show relationships in size and number, as well as orientation in space - up, down, near, far, left, right.)

As children gain experience in model-making and picture-making, their products becomre more detailed and complex. Not only do they attempt more in terms of the scope of these representations, but they add more and more details according to their perception of things, people, and events.

Model-making

(a) Individual or group models of playgrounds, plazas, neighbourhoods; use of miniature street lights, mail boxes, traffic signs, people and animals. (Positioning and proportions are still approximate.)

(b) Models of single items such as a house, a car, airplane or tower. (These become more complex in composition as children consider the parts, relationships, and functions of the component parts of the model.)

Picture-making

Picture-making now involves a greater variety of shapes, colours, and relationships in space. Through discussion it is possible to find out how children feel about certain colours, how they react to different shapes, straight and curved lines, composition.

Projection of images

An overhead projector can be used to examine enlargements and note correspondences. It is also useful for discussing colour and composition as the children move different shapes and different colours around to see what happens.

Ink-blot patterns

Children make ink-blot patterns by folding paper with one, two, or more colours of finger paint. With experience, they will experiment with more complex symmetries and attempt to predict and then describe shapes and relationships.

Figures on a geo-board

Children make figures on a geo-board by (i) copying given figures (same shape, same size), (ii) enlarging or contracting given figures (same shape, new size), (iii) distorting given figures (new shape).

Scale models

Design activities using scale models of cars, airplanes, ships, animals, and people in situations where the surroundings -- trees, streets, houses, hills and rivers -- are made in proportion. (Repeated experiences of this nature not only increase children's skills in approximating and scaling but assist them in seeing objects from different points of view).

Shadow play with a shadow box

Make a cardboard box with translucent windows of paper on the sides and top and equip it with a source of light such as an electric bulb or flashlight. When an object is placed in the box, its shadow is projected, which the children attempt to interpret and draw.

Proportional models

Children reproduce large scale figures and shapes using smaller units; produce designs in different colours and with different materials; reproduce models, designs, and pictures, keeping the basic shapes and relationships but exaggerating dimensions such as length or thickness.

It should be noted that the activities outlined so far do not involve formal measurement. The representations are based on the child's perceptions of size and relationship using visual clues and approximation.

As the child matures and sees the need for more precise forms of recording, the activities will involve measurement, scale, and the use of more conventional symbolism. The investigations should grow from very simple and familiar situations to projects involving broader and less familiar areas. Paralleling the actual map-making will be other activities designed to improve related skills in classifying, measuring, number work, and representation.

Model-making

Model-making activities emphasizing proportions and the need for scale; matching both 3-D and 2-D models which differ in orientation and proportion; measuring parts and whole, proportion of unit to whole.

Suggested Activities for the Development of Graphs

Graphs provide the children with systematic ways of organizing, classifying, and recording the information they find in their investigations. They can have a strong visual impact and should help the children in analyzing this information and in making conjectures.

The children should be encouraged to discuss their investigations with one another, using the graph as a means of communication. Occasionally, the graphs made by one group of children should be given to another group without any verbal commentary. The latter group could them be asked to explain what the graph communicates to them. If the graph doesn't communicate effectively by itself, then the two groups should meet to find out why and to make suggestions for improving it.

The activities that are described below are but a small sample of the many situations suitable for investigation and subsequent representation by graphs. They are based on observations of children and teachers working together and illustrate a growing sophistication in the graphs which parallels the growth in children's maturity.

For each sample activity and graph, related mathematical ideas are identified. These show the undercurrent of mathematics that flows through the activities and which will help the children to accumulate many concrete experiences in preparation for the formal study of these concepts. These ideas should be particularly encouraged in the early years, but at the same time should be treated in an incidental way during discussions of the investigations.

Activity 1.

The skills of graphing and map-making are very similar for young children of ages 4-7. Here, as in Activity 1, the actual objects of the investigation are used in building the graph or representation; in map-making, representative objects are chosen. As situations are introduced in which the objects to be sorted are too large to move or are fixed in position, the children should be encouraged to use representative objects in the hoops.

Activities 2-6.

In these samples, the physical objects cannot be sorted and organized conveniently. Hence, words, pictures, and physical objects are introduced to represent the real things; the representations are early stages of bar graphs, in which, generally speaking, the units are chosen, bear a strong similarity to the real objects.

Activities 7-9.

In these activities, more arbitrary units are chosen to represent the real things; gummed squares are pasted one after another to build the bars, then strips of ribbon or paper are cut to represent the accumulation of squares, and finally the bars are marked and shaded. Different colours are used to distinguish the objects. In this progression, the form of representation becomes increasingly more abstract but has the advantage of being more easily constructed. This parallels the general development of mathematical notation, in which mathematical ideas are presented in increasingly symbolic and abstract (removed from reality) forms, yet which have the decided advantage of brevity and convenience of manipulation.

Activities 10, 11, 13.

In one respect, the graphs developed here are less abstract than those in Activites 7, 8, and 9. The actual strips of ribbon or string used in the measurement are pasted on the graph; thus, the graphs can be made independent of numerical measurement. Comparisons can be made qualitatively of the relative lengths of the strips and thus of the things they represent. Patterns can be recognized from the graphs. Then these comparisons and patterns can be expressed quantitatively by measuring the "bars" and comparing these measures numerically. For example, the children may discover qualitatively that the waist size of one child is double the neck size and that this in turn is double the waist size. This can be checked numerically, and the generalization made that a person's wrist, neck and waist measurements relate in the ratio of 1:2:4. Sometimes the lengths of strips of ribbon are too long for display on the graph sheet; these lengths can physically be scaled to $\frac{1}{2}$, 1/3, or $\frac{1}{4}$ of the former lengths by simply folding, then cutting the ribbons. Even then, scaled representations may be constructed in which the ribbons are replaced by shaded bars. This final form of the graph is more convenient in size and permanent in form, but is less representative of the original situation - the degree of abstraction has been elevated.

Activity 12.

This activity is interesting in that the investigation itself builds a visual representation of the relationship of the mass to the length of the elastic. The picture, in effect, is copied when the graph is made. The activity can be extended further by suggesting that a new graph be made from information in the first graph to compare the extension of the elastic to the mass added. In this case, a straight line drawn through the ends of the bars will pass through the "origin". A "direct variation" representation has emerged from the "partial variation" picture.

The children can be encouraged to explore situations in greater depth by asking pertinent questions at the right moment. The following are examples:

Activity 1 - "Where would you place a red and black glove?"

Activity 3 - "What happens if we use different sizes of paper for the pictures?"

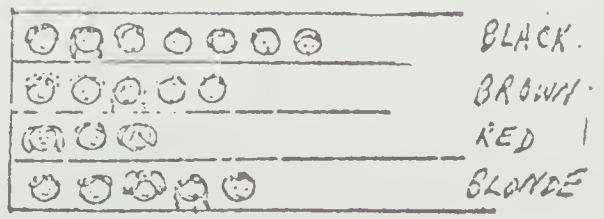
Activity 5 - "Should you use bigger blocks for buses than for cars?"

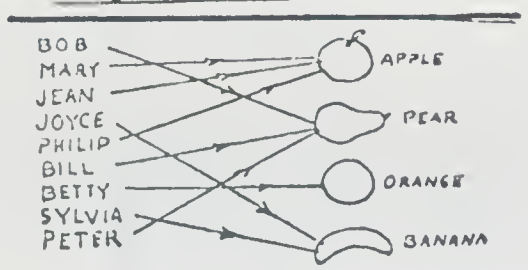
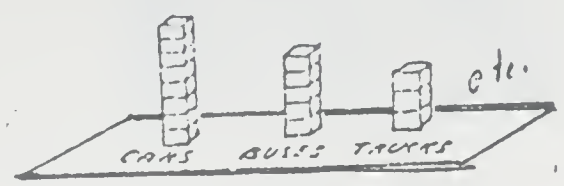
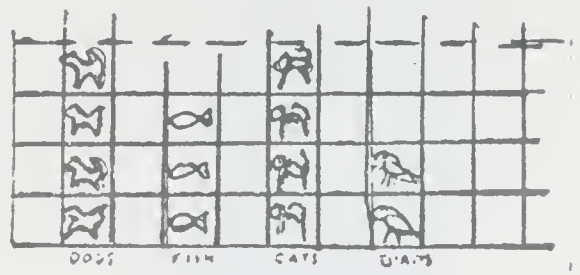
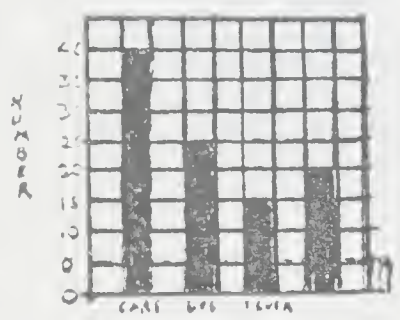
Activity 7 - "Can the length of the bar be a fraction?"

Activity 10- "How much larger is Joe's waist than his neck? Mary's waist than her neck?", etc.

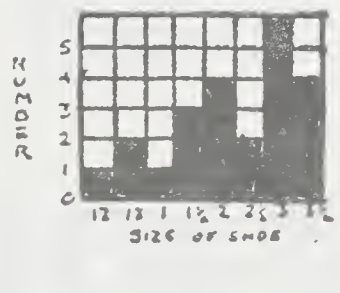
Activity 12- "What will happen if you add one more mass? then one more? and one more? What will finally happen?"

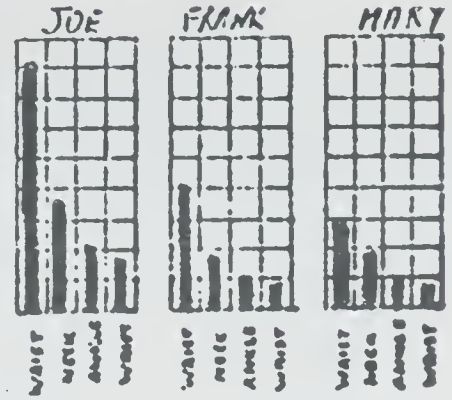
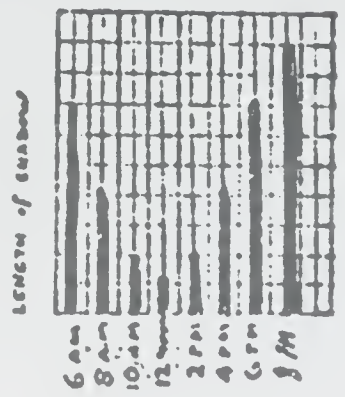
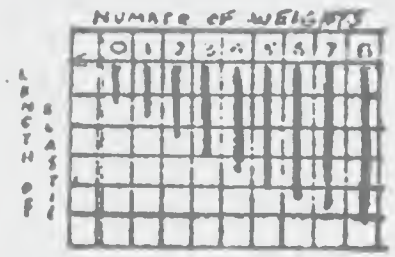
Stages in the Development of Graphs

Activities	Sample Graph	Mathematical Ideas
1. Sorting Children sort their mitts by colour, placing them in hoops or in loops of rope. Children could sort other objects according to other attributes.		. Recognition of an attribute (colour) . Making collections of things having the same attribute (red, black, etc.) . Possibly intersecting sets (where does a red and black mitt go?) . Sorting by a new attribute (size, material, etc.) . Concrete experiences with Venn diagrams.
2. Favourite Colours Each child draws a picture of himself and pins it on a large coloured sheet of paper on the display board. He selects the colour. Which colour is most popular? Which is least popular?		. The representation is independent of the size of the unit (picture) . Counting . 1-1 correspondence, ordering . The conclusion is based on numbers
3. Hair Colours Each child draws a picture of himself on identical sheets of paper, and colours his hair. The pictures are displayed by colour, side by side. Comparisons are made.		. Concrete experience related to bar graphs . The representation requires equal units (sheets of paper of the same size) so that comparisons may be made visually from the graph . Comparison of numbers is based on the relative lengths of the strips . Pictures must line up vertically and have a common starting line . Ordering

Activities	Sample Graph	Mathematical Ideas
4. Favourite Fruits Children make vertical lists of names and fruits. Each name is mapped to the child's favourite fruit.		. Many-to-one mapping (possibly 1-1) . Correspondence . Possibility of inverse relation (Which children like apples?)
5. Traffic Count Children make a traffic count of cars, buses, trucks, bicycles, motorcycles for a short period of time. The data are displayed using stacks of blocks.		. Concrete experience related to bar graphs . Congruent blocks are needed . A common base is needed, no vertical scale . Colour coding can be used to distinguish cars, buses, trucks, etc. . Ordering . Counting
6. Favourite Pets Each child makes a drawing of his favourite pet on identical sheets of paper. These are displayed on a rectangular grid.		. Concrete experience related to bar graphs . Equal units are used (sheets of paper of the same size). . Common baseline with spaces labelled . If each child identifies his pet, early ideas of co-ordinates can be introduced.
7. Traffic Count The same investigation as 5 is made over a longer time period, using tallying. The data are displayed in a bar graph.		. Bar graph . Common baseline with spaces labelled . Vertical scale with lines labelled . Ordering . Tallying in base five . Bar can be a strip of paper or shaded . Only whole number cuts are made. Why?

..../3

Activities	Sample Graph	Mathematical Ideas
8. Family Sizes Each child reports the number of children in his family. A tally is made of the number of families with one child, two children, three children, and so on. A graph is made to illustrate the findings.		. Same as 7.
9. Shoe Size Each child reports his shoe size. A tally is made of each size then a graph made . The data in 8 and 9 can be collected for a number of classes and combined in a single graph.		. Same as 7. . The vertical scale will need to be compressed to accommodate the larger sample of children.

Activities	Sample Graph	Mathematical Ideas
10. Body Measurements Each child measures the size of his waist, neck, ankle, and wrist. Different coloured strips are used and cut to the actual measurements. These are displayed as a bar graph for each child. Comparisons are made. Make ½, ¼, 3/4 scale models of these measurements.		. Bar graph contains actual measures . No vertical scale is needed . Continuity of measures (a taste of real numbers) . Ordering and comparison . Possibilities for students to conjecture . Scale, fraction
11. Shadows The shadow of a brick is drawn at suitable intervals throughout the day. Its length is measured, using a strip or standard units. The data is displayed on a graph and discussed.		. Bar graph, but bars are now vertical segments . Times are marked on the line (not the spaces) Why? . Continuity, intermediate values . Smooth curve through the end points, interpolation . Symmetric form of the curve . Least value. Greatest value? . Congruent shapes . Extending the graph in either direction. Is this possible?
12. Stretch of Elastic Bands Use a set of nails equally spaced on a horizontal line. Hang elastic bands on the nails and a set of identical weights on the elastics - one on the first, two on the second, three on the third, and so on.		. Graph resembles the experimental situation . Scales on the lines, not the spaces . Continuity implied; if intermediate weights used, fractions . Smooth curve through end points, straight line, interpolation . Extending the graph in either direction. Is this possible?

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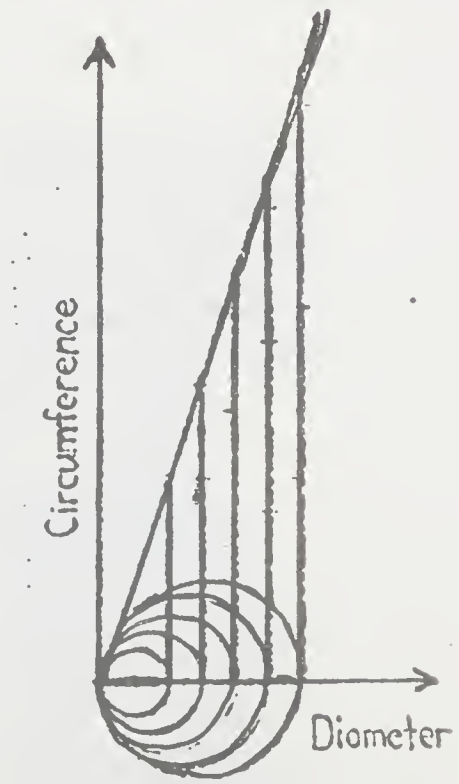
Activities	Sample Graph	Mathematical Ideas

13. Diameter vs Circumference

Ribbon or paper is used to measure the diameter and circumference of different circular lids -- a new colour for each lid.

A graph is made by placing the shorter lengths of ribbon (representing the diameters) horizontally, and the longer lengths of ribbon (representing the circumferences) vertically.

How are the lengths of the two ribbons related?



- Perimeter of circular discs
- Measurement without standard units
- Graph uses the concrete materials of the investigations
- Comparison of lengths by division
- Direct variation
- Circumference/diameter is constant, approximately 3.1

DRAFT ONE

Support Document #10

Observation

Objective:

To help children develop the skill of obaservation with special emphasis on the use of measurement to refine observation.

Introduction:

This booklet is designed to:

a) help the teacher assess children's present observation skills

b) help refine observation skill through measurement in the context of inquiry

c) help the teacher and children plan appropriate activities.

In addition, the booklet offers suggestions for activities and suggestions for evaluation.

Observation is one of the inquiry skills identified in chapter 6, "Environmental Studies" of Education in the Primary and Junior Divisions.

Some children will have better developed observation skills than others. It is the teacher's task to assess the development of their skills and to plan activities with them to refine those skills. Through observation, children will develop the ability to:

a) tell the difference between objects by exercising the sense of taste, touch, sight, hearing, and smell. Examples: This object is grey and that object is brown. This ball is smooth and that cloth is rough.

b) distinguish an observation from an inference (an inference is an explanation or interpretation of the observed facts). Example: This is clear; it has no taste; it feels wet; it has no smell; it puts out a flame: I infer that it is water.

c) extend the scope of observation by subjecting the object under observation to certain tests and experiments. Example: When I blow this balloon up, the colour changes. I can scratch this object, but I can't put a scratch on this other one.

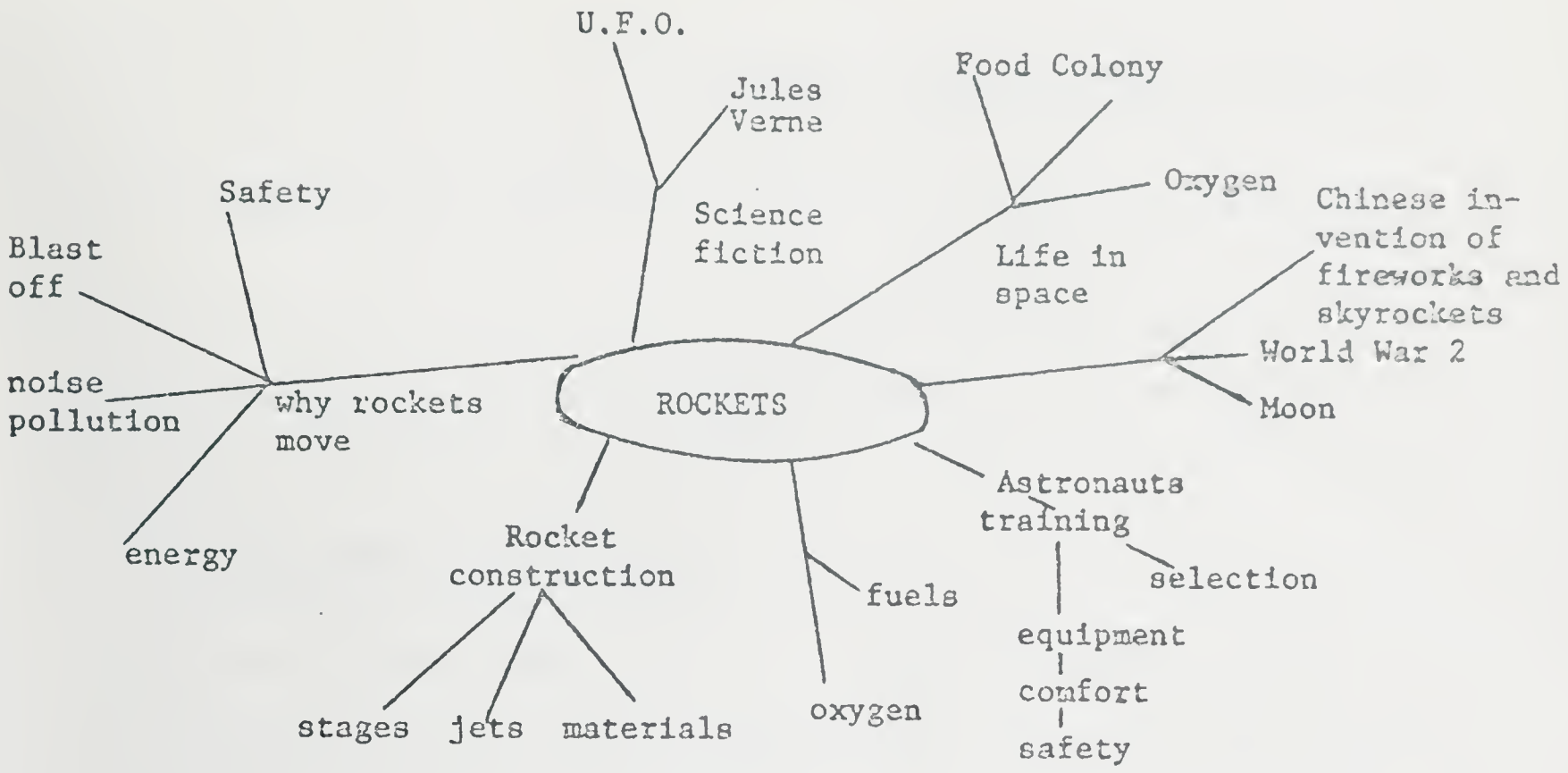
d) extend the use of their senses by means of an instrument such as a magnifying glass, a telescope, a magnet, or a microscope.

e) refine observation through the use of a measuring device such as a ruler, thermometer, air-pressure gauge, or balance.

f) repeat observations in order to improve the accuracy of the data.

A starting point for developing the objective

As children develop themes, many opportunities are presented to introduce experiences using the skill of observation. The following learning web on rockets may grow out of a common class experience with toys that employ the rocket principle:



A group of children may wish to investigate why rockets move.

The teacher can use this branch of the web as a vehicle for developing the skill of observation through measurement. Other groups in the class may pursue the other branches of the theme to achieve the same or other learning objectives. The teacher must first assess the observation skills of the children.

How well can the children observe?

In assessing a child's ability to observe, the following questions may be useful:

1. Does he use all appropriate senses when identifying an object?

2. Can he distinguish an observation from an inference?

3. Does he manipulate or make physical changes to the object when making observations?

4. Does he use measurement to refine his observations and to be able to communicate them more accurately?

Answers to the above can be obtained through observation of and discussion with the child. On occasion, it may be necessary to set up a situation in order to assess his ability. For example:

Materials: One round balloon, one metric ruler. If possible, have a balance and magnifying glasses available. Draw a circle on each balloon about the size of a twenty-five cent piece.

Procedure: Give the child a balloon and a ruler; draw his attention to the other aids available. Have him write down all the observations he can make. Discuss each statement, asking what sense was used in the observation. Write down the name of the sense used beside each observation; for

example, the balloon is shinier after being blown up (sight). When you come to an inference, mark it and clarify the difference between an observation and an inference.

The answers to the questions on the preceding page will indicate the areas that require further development. The teacher will likely find it valuable to keep a written record of the assessment of each child.

The teacher will also need to evaluate the child's ability to work independently and interdependently. At first the child may be dependent upon the teacher and will need much assistance. As the teacher helps him to extend his skills, he will become more self-directed and independent. An independent learner initiates his own inquiry, poses his own questions, and finds the answers to them. The interdependent learner goes through the same process but works co-operatively with a group on problems and questions the group has posed.

The following activities illustrate why rockets move and suggest opportunities for developing the skill of observation. According to his assessment of the child's ability to work independently, the teacher may wish to supply instructions for the whole activity or part of it, or he may decide to interfere in child-initiated activities only as needed. Activities may be devised through discussion with the children.

Activity #1

Can an aluminum pan be moved using one balloon and straws?

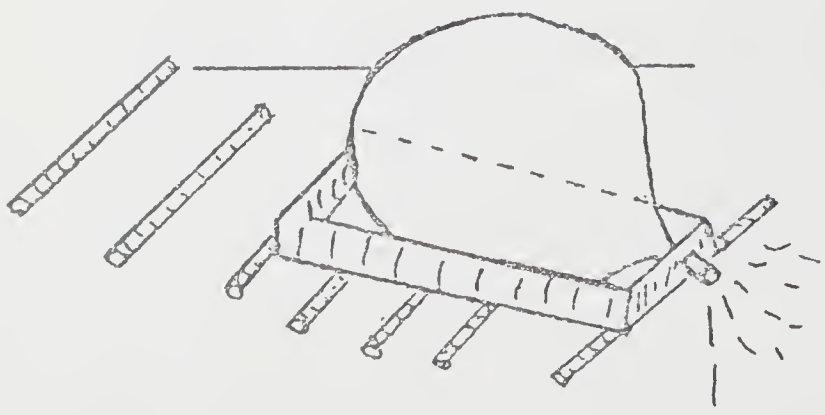
Use a blown-up balloon for the push, masking tape to attach it to the pan, and straws for a road.

When the experiment has been completed, measure how far the pan has moved and discuss your observations. Fill in the table. What are some of the conditions that determine how far the pan will move?

Tell someone what you found out. How could you have improved this experiment?

Trip Number	Distance (in cm)
1	
2	
3	
4	
5	
6	
7	

Empty aluminum foil cake pans are excellent. Quality round balloons are the best.



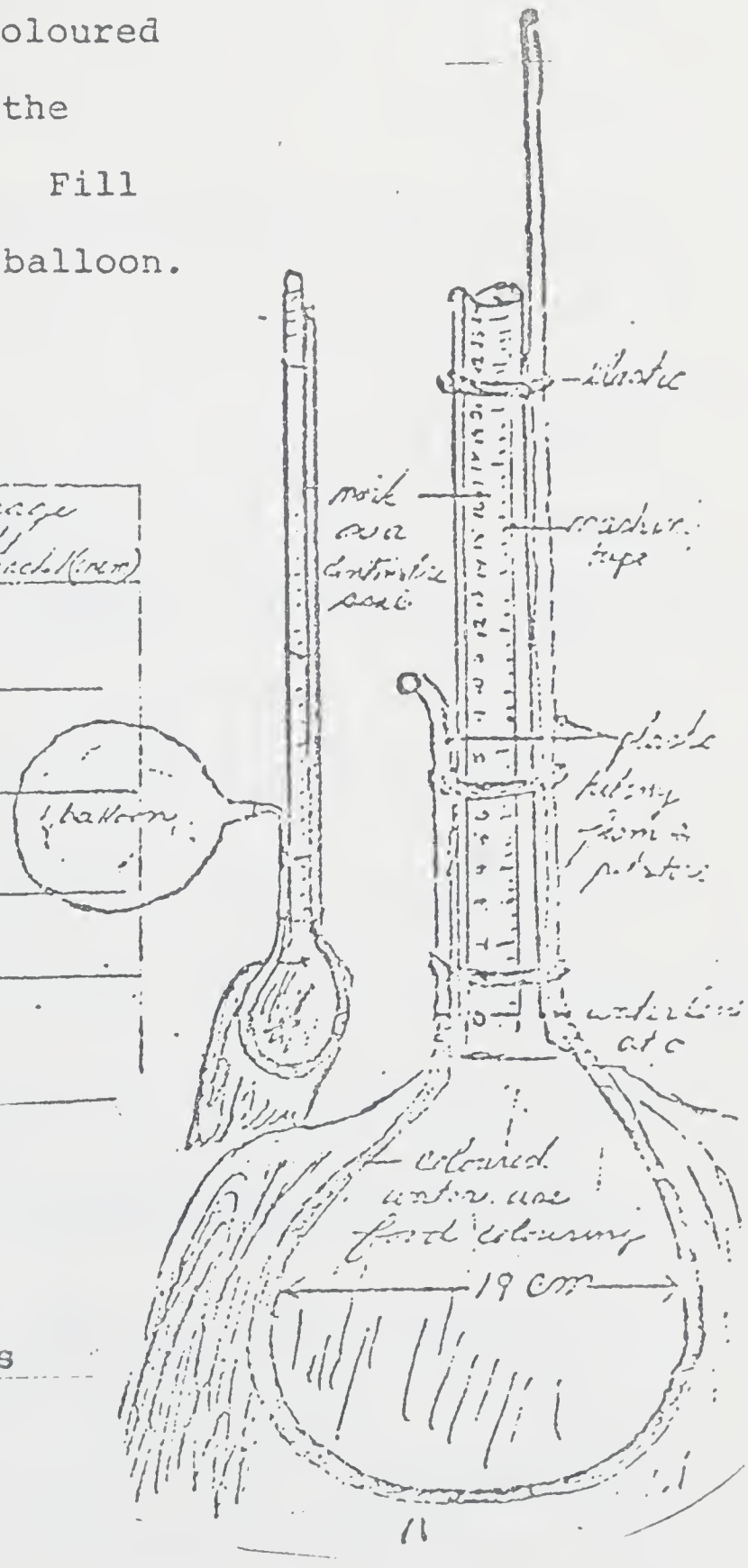
You may experiment with variations - e.g., try to use two balloons or make a hovercraft with one balloon to supply lift, using the other for horizontal thrust.

Activity #2

Determine which of three balloons has the greatest blow or thrust.

You can use the balloon thrust gauge to determine which of the balloons has the greatest blow. The higher the coloured water goes in the plastic tube, the greater the blow of the balloon. Fill in the following table for each balloon. Discuss your observations.

Balloon	Trial number	Height reached by water (in cm)	Average height reached (in cm)
The red one			
The twisted one			
The green one			



Communicate what you found out.

How might you have improved this experiment?

Evaluate your contribution.

Activity #3

Determine which balloon has the longest blow using the balloon thrust gauge and a stopwatch. Try the experiment without a stopwatch.

Use a table to record your measured observations.

Activity #4

Design a model jet that travels along a wire.

Use a table for recording your measured observations.

Activity #5

Build a two-stage rocket using two balloons.

Children could work in teams, each team trying to set a class record for distance.

Use a table for recording your measured observations.

Some children may suggest other ways of investigating the same principle. Here are two examples:

Activity #6

Observe what happens when you push an object.

Push something one way, does it push back?
Observe what happens to you when you throw a medicine ball forward while you are standing on roller skates. Discuss the observations. Communicate to others what you found out. How might you have improved your experiment? Evaluate your contribution.

Activity #7

Determine why some throws will move you back farther than others.

Does the distance travelled backward depend on how hard the ball was thrown? Work in teams of three or more. Tape three lines on the floor at one metre intervals. One child wears the skates and is the thrower. One child records the observations in a table and steadies the thrower on the line as he prepares to throw. Start with the front wheels of each skate on the line. Throw the ball four times, trying to hit the one metre line each time; then throw the ball four times trying to hit the two metre line each time. The third child measures the distance moved backward with each throw. Measure from the starting line to where the front wheels come to rest. Children should rotate tasks.

Complete a table for each thrower; then discuss your observations. What conclusions do you draw from your observations?

Name.....Child's Mass.....(in Kg)					2.2 lb = 1 Kg
Throw number	One metre line		Two metre line		
	Distance moved backward (in cm)	Average (in cm)	Distance moved backward (in cm)	Average (in cm)	
1					
2					
3					
4					

Show your data to someone who was not a team member. Tell them what it means to you. How might you have improved your experiment? Evaluate your contribution. Devise a similar experiment to determine if the mass of the object thrown affects the distance travelled.

The activities that follow will help children to apply the skills of observation, using measurement, to problems in their community. The data they gather should help them to understand their environment better and provide a better factual basis for making value judgements. Children will have many other questions that they may research using similar methods.

Activity #1 - Bicycle Check

How safe are the bicycles in our schoolyard for riding on the streets? Will they pass a safety check?

1. Work in teams and observe the bicycles in the yard. Check them against the list that follows. You may wish to build your own checklist. To pass the check, a bicycle should have all of the items except those marked optional.

- ☐ tail light
- ☐ bell
- ☐ mud guards
- ☐ chain guard
- ☐ missing parts, spokes, handles, grips, loose parts
- ☐ tires with no tread
- ☐ tires underinflated
- ☐ light for night (optional)
- ☐ basket (optional)

Also record the number of girls' and boys' bikes.

2. Find out the total number of bicycles that passed the test. How many did not? How many were boys' bicycles? How many were girls' bicycles? Which items were most often missing?

3. Make a table of your information. Report your conclusions by displaying your information in a way that will attract the interest of those concerned. How can you encourage the owners of bicycles that failed the test to make their bicycles safe?

For further investigation

Do the children in our school know the safety rules for riding a bicycle on the road? Can the children in our class ride a bicycle with the skill necessary for safety on a roadway?

Activity #2 - Car Check

Is gasoline being wasted in our community due to a preponderance of cars containing a single occupant? Are most of the cars driven in our community without a passenger?

1. Form teams and select observation points (intersections are best). Select the points in such a way that the same car is not likely to be counted several times. Teams should station themselves at their intersection at different times

of the day and observe the cars that pass to gather the following information:

(a) How many cars passed?

(b) How many passengers were there in each car?

2. Repeat this activity for several days at each observation point and at the same time. Total the information in a table as illustrated below.

A	B	C	D	E	F
Time of Observation	Number of days observation made	Total number of cars observed	Total number of cars with no passengers	Total number of cars with one passenger	Total number cars wi one or more passen
10:00-10:30 a.m.	4	15	10	3	2

3. Share your observations with the other teams in your class. Total the C, D, E, and F columns of the tables from all observation points. Report your findings, stating columns D, E, and F as percentages of the total in column C.

For Further Discussion

What reasons could there be for travelling one to a car?

Examples:

(i) emergencies

(ii) driver returning from delivering passengers

(iii) no one else going the same way

(iv) taxi service

(v) business calls

(vi) other - explain or infer

Activity #3 - Student Radar

Do the cars that pass our school travel within the speed limit?

1. Measure off 100 metres at the front of your school. Put a white post beside the road at the beginning and end of the 100-metre line.

2. Borrow a stopwatch from your teacher. Time the number of seconds it takes a car to pass between the posts. Calculate the speed of each car that passes and record it in kilometres per hour on this table. If a car travels the 100 metres in seven seconds, how fast is it going?

Car	1	2	3	4	5	6	7	8	9	10
lometres r hour										
me in conds										

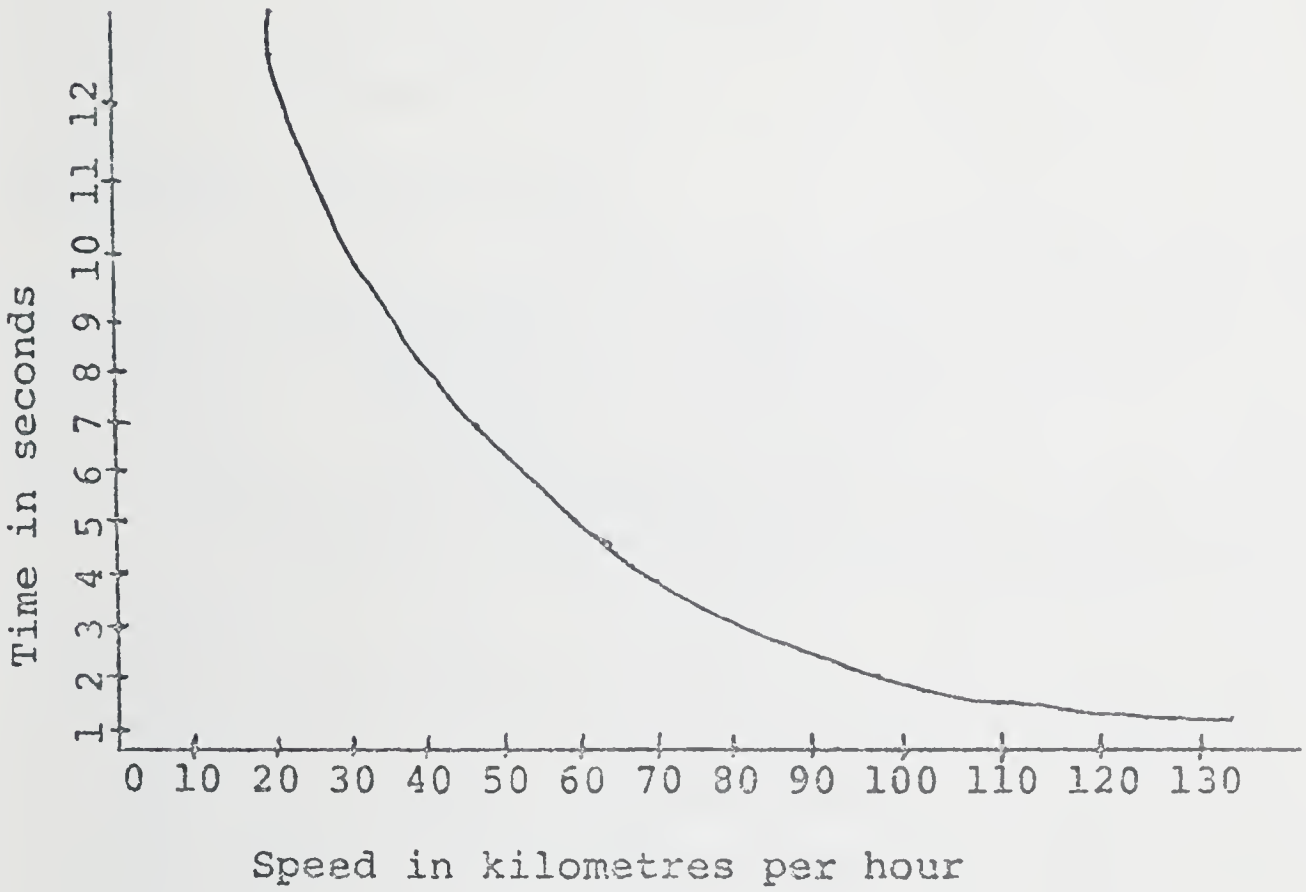
3. What is the speed limit in front of your school? Find out what this speed limit is in kilometres per hour. How many cars travelled above the speed limit? How many below? State these results as percentages. Ask your

principal to include your findings in the next newsletter he sends home to parents. Through what other means could you inform the public about your project? Have your team evaluate your study. Where did you need the most help from the teacher? Design another activity like this one to help you find out more about your community. Should the speed limit near your school be lower or higher than it is? Explain the reasons behind your opinion.

The conversion to kilometres per hour can be speeded up by the use of a table such as the one given below. It could be a very useful activity to make one of your own.

Time in seconds to travel 100 metres	Speed in kilometres per hour
12	30
11	33
10	36
9	40
8	45
7	51
6	60
5	72
4	90
3	120

Or you could develop a conversion graph for ready reference.



Activity #4 - Bicycle-tire check

Are most of the bicycles used by members of our class underinflated to a dangerous extent?

1. Form teams and check the tires of all the bicycles owned by members of your class.

2. Check with the local bicycle sport shops to find out the pressure to which each tire should be inflated.

3. Chart your findings on a table like the following:

Vehicle	Pressure		Pressure recommended by manufacturer		Does the vehicle have correctly inflated tires?	
	Front	Back	Front	Back	Yes	No
Example 1						
2						
3						
4						
5						
6						

Note: Tire pressures are given in pounds per square inch in the imperial system. What does this mean? Can you demonstrate a pressure of one pound per square inch? As we switch to the metric system, what will tire pressures be measured in? Are there any pressure gauges calibrated in these new units? If not, when might they become available?

4. Ask your principal for permission to conduct a similar investigation of the car tires in the teachers' parking lot.

5. Your team should investigate such questions as why it is dangerous to have underinflated tires, overinflated tires, one tire at a different pressure from the other. Share your findings with the rest of the class. Can you think of effective ways of communicating your findings to the class sc they will keep their bicycle tires at the right pressure? Evaluate each step in your experiment.

For Further Investigation

How does a tire pressure gauge work? Is it related to the principle of the rocket? How does the valve in the tire work? Where else are valves used?

Activity #5 - Pollution Probe

Do people pollute our neighbourhood with refuse?

1. Teams of children could observe their own schoolyard, a neighbouring park, shopping plaza, or woodlot for evidence of litter or pollution.

2. Classify the pollution you find into categories. Make a bar graph to show the number of incidents of pollution in each category. Draw a map of the area to show where you found the pollution.

3. What is the most common item of pollution you found? Why? What area had the most pollution? Why? Who should you contact in the community to help control pollution? What are the effects of pollution in these areas? Report your findings to the rest of the school in your school newspaper. If there was little pollution, you should report and comment on that fact as well. How can you improve your contribution next time? Where do you still need help from the teacher? Could you have used a different method of communicating your findings?

For Further Investigation

Is there more pollution in our schoolyard than in other public places in the community?

Evaluation

A continuous assessment should be carried out throughout all activities, both those suggested here and those that the teacher and children may devise. The teacher should assess each child's ability to observe by answering, through observation and discussion with the child, the questions given on page 4. The teacher's record will likely show a progressive development of observation skills and point the way toward further development.

The child should be encouraged to evaluate his own progress. He might ask hemself questions such as: Did I achieve the individual or group contract I made with the teacher and the

objectives we set? Did I observe accurately? Was I able to answer all my questions from my observations? Are there new questions that suggest further investigation? Was the approach I used for solving the problem the best one? Was there another way I could have done it? Did I choose the best method for sharing my results? Was there a better method? How can I improve the evaluation of my own activities? What new activities might I design for myself to answer other questions about my environment?

The teacher will also likely wish to evaluate the child's progress in being able to work independently and inter-dependently.

Evaluation in the affective area of learning may be more subjective than in the mental skills area. The following questions may be useful in keeping an "anecdotal" record of the child's growth in the affective area.

- How has the child grown in his ability to make value judgements based on his own observations?

- What individual interests, attitudes, and feelings has he revealed in the study being evaluated?

- Did he consider alternatives as well as the consequences of each choice in making value judgements?

- In making a value judgement, to what degree did he accept - or reject - observed evidence?

- Was he happy with the choice he made?

Evaluate the process through which the child arrived at his value decisions in the context of the activities. Where is he showing growth? Evidence of growth of this kind will help you to make better value decisions yourself with regard to the child's development.

Support Document #11 Consumer Studies

and Curriculum Guidelines Primary & Junior Divisions 1975. #11 c.2

This unit provides guidelines, makes suggestions, and presents examples that the teacher may use in applying a decision-making model that has general application to Consumer Studies. While the decision-making process can be applied in any area of the program where some choice is required, it is especially applicable to Consumer Studies. As noted in the curriculum guideline Consumer Studies 1972 the child in modern society is called upon at an increasingly early age to make decisions involving the use of resources as well as to influence others in this area.

This unit illustrates ways in which the child may be helped to gain competence in decision-making through choosing a hobby. (The word hobby is used here to include any pastime or activity that is not dictated by some other person or persons.) The child might decide (for example) to play a team sport or a musical instrument, to learn to ski, form a club, collect postcards or records, make models, or learn a craft. Through this activity the child will have opportunities to experience a decision-making process, to learn some of the factors a consumer must consider, and to clarify and develop his own values. Such a study should help each child set priorities and make decisions consistent with them. Looking at values in a group situation may lead a child to clarify his own beliefs and give him the opportunity to articulate his own opinions.

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The open-ended approach suggested here provides for the needs and interests of children with a wide range of capabilities. Each child, whatever his ability, should be able to engage in some challenging and appealing hobby. It is the responsibility of the teacher to see that each child finds the work challenging and personally satisfying.

This approach lends itself to two types of integration - thematic content and thinking skills.

The theme hobbies cuts across subject disciplines. For example, in collecting data, organizing information, and presenting findings to others, the student relies on communication skills both in language and mathematics. The child will need the skills of reading, writing, listening, speaking, using the library, interpreting filmstrips, tables, and graphs, calculating costs in experimenting with products, examining effects on health, and considering wise use of resources. Various aspects of the arts can express feelings as well as convey the subtler details of information.

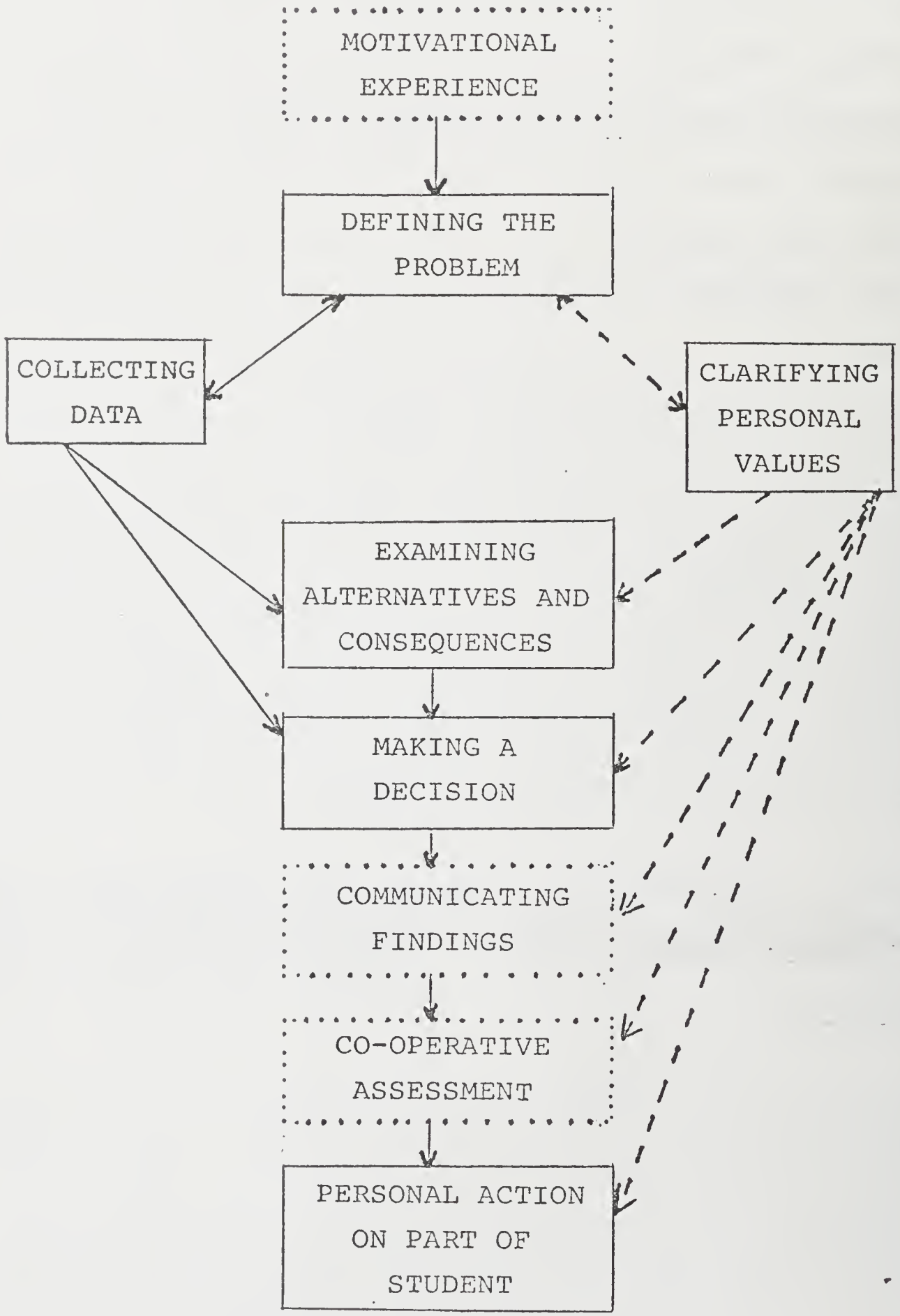
In addition to integrating learning around an area of content or theme, consideration should be given to organizing learning in various disciplines around a thinking skill. Learning to observe, classify, predict outcomes, and determine relationships are but a few of the many thinking skills that apply to all subject disciplines and in fact to many life situations. The skill of decision-making illustrates this type of integration.

Organizing the Children for Learning

There are many ways of organizing the children in the study of this unit. The choice depends largely upon the degree to which individual children are able to work independently and interdependently and on the confidence of the teacher in handling an open-ended approach. Children in the class who have learned to accept freedom with responsibility can work with considerable independence while others are engaged in activities requiring much more direction. Because of limited resources, some teachers may wish to have only half of the class working on this topic at any one time. With the aid of parent volunteers, some children can carry out investigations outside the school while others work in the classroom. In some instances, teachers may wish to combine classes and plan the work as a team.

The key to organization is flexibility, taking into account the individual differences of children and the confidence of the teacher.

Generalized Decision-making Model



The boxes with solid lines indicate the steps that apply both in and out of the classroom. The dotted lines indicate steps applying to the classroom only. The broken line arrows indicate that value clarification strategies can be employed at any step in the process.

Preparing a Unit

Considerable preparation is needed for a topic in Consumer Studies. Three areas in particular need to be examined.

The teacher must know:

. the children's concerns and interests
. parental expectations (which vary from one community to another)
. societal expectations

Having given attention to these areas, the teacher might consider topics such as the following:

. recreation
. hobbies
. advertising
. symbols and the consumer
. care of school resources
. buying a product (bicycle, gift, sports equipment)

When the topic has been selected, further preparation is required. The teacher, assisted by the children where possible, collects or locates resources both human and natural. He also prepares by becoming as familiar with the major ideas as he can.

Developing a Unit on Choosing a Hobby

Motivational Experience

The initial step is designed to arouse the interest of the children and focus attention on possible problems to investigate. There are many starting points:

. interviewing people in the community about their hobbies
. visit to hobby show, hobby store
. displays of children's hobbies
. children's reports on their hobbies or those of their parents or other relatives
. display of pictures, models
. collection of books on hobbies
. slides, films

Defining the Problem

If the motivational step has been sufficiently exciting, many different ideas have been created in the minds of the children. The children need the guidance of the teacher in narrowing the problem to a manageable unit after examining various possibilities and determining priorities.

As problems are suggested, the teacher helps the children refine them in terms of clarity and practicality. One problem may be selected so that small groups or individuals may pursue different aspects of it. On the other hand, each group might study a different problem. Although the children may work in groups to help each other share resources and findings, it is important that each child realize that ultimately he has to make his own decision.

Example of a problem: <u>What Hobby Should I Select</u>?

To make a decision, the child should be encouraged to collect and examine data from as many relevant and practical sources as possible. Some of these might be interviews, visits to stores, simulations, case studies, newspapers, magazines, pamphlets, books, surveys, experiments, films, tapes, and filmstrips.

For example, two children who were interested in chemistry sets conducted a survey of prices in local stores. From the results, they became aware that the size and quality of the article must be considered in price comparison.

Here are the results as the students tabulated them:

CHEMISTRY SETS

Place or Company	Size	Cost
Store "A"	large	$17.98
Store "B"	medium	$13.89
Store "C"	extra large	$33.00
Store "D"	large	$17.95
Store "E"	large	$17.99
	medium	$12.99
	small	$ 9.95

The children added a note of caution. Safety might be one of a number of factors to be considered in price comparison. A report such as the above could provoke considerable class discussion about factors to be considered.

The child then examines alternatives and their consequences. For example:

. How safe will my hobby be?

. How much do hobbies cost?

. What people might I meet in pursuing my hobby?

. What effect will my hobby have on my family or neighbourhood?

. What advantage is there in taking lessons in music, figure-skating, or hockey?
. How much time should I spend on hobbies?

After examining alternatives, the child actually makes a selection and acts upon his choice.

The next step is to communicate his findings; a variety of techniques may be used: graphs, models, pictures, role-playing, comic strips, drama, oral presentations, poems, and songs.

For example, in one classroom children working in pairs or small groups researched hobbies in the manner suggested above. Presentations involving various techniques were made to the class. Each group assessed its hobby in terms of seven factors that might influence a decision. The results were posted in table form and the entire class discussed the data confirming or suggesting changes in each groups assessment. Their table is shown below: (Code: H - High, M - Medium, L - Low)

QUALITY \ HOBBY	Candles	Coins No. 1	Drama	Chemistry	Morse Code	Fitness	Racers	Magic	Carpentry	Coins No. 2
Safety	M	H	H	M	M	M	H	M	L	H
Uniqueness	M	L	L	L	L	M	M	L	M	L
Friendship	L	M	H	L	M	M	H	H	M	L
Usefulness	H	M	M	M	H	H	L	M	H	H
Time	M	L	H	L	L	L	M	H	L	L
Cost	M	M	M	H	H	L	M-H	H	H	H
Relaxation	H	M	L	M	M	L	H	L	L	L

The teacher then asked the children to reconsider their findings in the light of new data (e.g. hazards in candlemaking of which they had not been aware).

Finally, the decision-making process should be assessed. Did the person or group collect data adequately, examine consequences systematically, and arrive at a decision logically? The purpose of assessment is to help each child profit from the experience so that he may make further decisions more effectively. This process of evaluation should be a co-operative task, shared by the teacher, the individual or group involved, and possibly other individuals or groups.

Once the child has chosen a hobby, the child will, on his own:

. implement his decision;

. accept the consequences of his decision;

. evaluate his decision after a period of time,

The decision made, the child can be helped to see how it reflects his personal values. Relevant classroom techniques should be developed to assist the child in clarifying his values as they relate to the real world around him.

Some techniques for clarification of values are rank ordering, values continuum, unfinished sentences, and values inventory.

Techniques for Value Clarification

<u>Rank-ordering by case study</u>

The following case study illustrates how the technique of rank-ordering may be used in the classroom.

Anne rides to school each day and goes for short trips on a bicycle that she inherited from her older sister. For the past few weeks she has been mentioning that she wants a new bicycle. She has started to save money for an expensive ten-speed model that she saw in a sports store.

For her birthday her grandparents give her a new bicycle. It is not a ten-speed and is half as expensive as the one Anne wanted.

After the birthday party the grandparents give Anne the bicycle.

Rank-order from 1 (most desirable) to 5 (least desirable) the action that Anne should take:

(a) Anne thanks her grandparents graciously for the bicycle, then sells it to one of her friends and buys the model she really wants.

(b) Anne thanks her grandparents for the bicycle and decides to use it instead of her older one.

(c) Anne thanks her grandparents for the bicycle, then leaves it in the garage where it may be stolen or damaged. She continues saving for the model she really wants and asks her parents whether they will help pay some of the cost.

(d) Anne tells her grandparents they should have left the purchasing of a bicycle to her since they don't know what models she likes.

(e) Anne uses the bicycle this year and considers buying the one she really wants next year.

Rank-ordering by coloured cards

The teacher gives each student a set of cards. The set of cards is made up of about seven different coloured cards, each marked with a word representing a value factor. All sets are identical; in the unit on hobbies the words on the cards are: cost, friendship, relaxation, safety, time, uniqueness, usefulness. The students are asked to arrange these cards in order of importance to themselves. The different colours allow students sitting close together to see whether their priorities differ.

A Continuum

Two extreme and opposing ideas or situations are developed in answer to a controversial question. One is placed at each end of a continuous straight line. Each student is asked to indicate where he would place himself along the line in relation to the positions stated at each end.

Who should decide classroom rules?

Summary

The value clarification techniques and decision-making model suggested here may be applied in many content areas. For example, the decision-making model, once understood, can be used both for group or personal decision-making. It can be used to solve such group problems as:

Which area of the community shall we study?

How will we raise funds for our class excursion?

What should we do about the equipment problem at noon hour?

It can be applied to such personal problems as:

How can I improve my spelling in written work (or my arithmetical computation)?

What changes in my way of living should I make based on my understanding of the availability of resources?

What should I do about the fact that Susan doesn't like me any more?

With continual practice in the use of these and other similar techniques or models suited to their stage of development, children will have commenced growth in a basic objective of all consumer education - independent, effective purchasing.

NATURE OF CHILDREN

SUPPORT DOCUMENT No.17

Draft

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> The professional must recognize the child or youth as an individual who thinks, feels, and acts uniquely within the bounds of the laws of human development. Man's behaviour must not be simplified when it is complex, not defined as fully explainable and controllable when there is still much to learn.
>
> Henry W. Maier, Three Theories of Child Development (New York: Harper and Row, 1965), p. 204.

The intent of the Complexities of Childhood chart is to present two views of human development - those of Jean Piaget and those of Erik Erikson, in an interrelated pattern. As stated on the chart, only some of the characteristics of childhood are recorded for each level. The best guide to the development of an individual child is the child himself; relating the child's behaviour or performance to a characteristic on the chart, however, may give the observer some confirmation of the child's stage of development. The observer's ability to perceive what a child can do, according to his stage of development, will develop concurrently with his awareness of the interdependence of psycho-social and intellectual growth.

Often the observations that an adult makes of a child's behaviour can be distorted by the observer's own self-image, by externally imposed expectations, and by the conventions of society, with the result that his evaluation focuses on what the child is

unable to do rather than on what he can do; the child himself is lost to the viewer. The adult who sees a child's performance as an indication of his unique stage of development and who responds in a way that leaves the child free to go on developing is truly observing the child. Inherent in such observation is the sensitivity to comprehend who the child is and the realization that without this understanding there can be no meaningful interaction.

Fundamental to development is a sense of trust - trust in others and trust in oneself. Each of the following case studies illustrates an observer's awareness of a child's need for a sense of trust. In each case, the teacher's interaction with the child also reflects her awareness of the child's unique pattern of development. The observers had no knowledge of the Complexities of Childhood chart at the time these observations were made.

Case Study 1

Student: Danny, age 3 years and 11 months. He comes once a week for about 1½ hours. At first he was reluctant to leave his mother.

Observer: Danny's neighbour, a retired teacher.

Situation: Living-room with toys.

Comments

- Danny saw the ball with the openings for inserting the various shapes. He quickly inserted all the shapes, needing help with one or two.

- Then he picked up the Matrioska doll (4 nesting dolls), took it apart, put the smallest inside the biggest, put the upper and lower halves of the other dolls together and counted 3 dolls, saying one was hiding. Then he opened them all and, with a little hesitation, got them nested.

- He got out the nesting blocks and, putting them open side up, removed one block at a time, chattering about the pictures on the sides. He hid each one under the next one removed, by reversing the block and placing it over the smaller one. He is still concerned that the smallest block isn't open on one side.

- For the first time, the 22-ringed wooden cone was stacked smallest to largest. Until now he had removed the rings and replaced them in random order. He looked at it and said, "I'm not going to play with that... but why does it look like that?" The difference in appearance had obviously registered!

- He ignored the houses.

- He next moved to the farm and wanted help in getting everything out of the box. He designated the areas, said he was going to get a farm for Christmas, and inquired again about the shepherd's crook (still calls the figure the "sheep man"). He cut grass with the mower, trucked it in from the field for

the animals, naming each variety. He held up a lamb and said, "That's a little sheep? If it's a little sheep, why do you say lamb?" This time he put hens and ducks together and rabbits by themselves. He played with the farm for twenty minutes and then put the pieces away with my help.

- He got the nesting jars,which he calls "doing the magic". He nested them without help.

- Next he got the large wooden blocks and spent half an hour building houses, bridges, and tunnels. He started out with a witch's house but soon decided it wasn't a witch's house.

- He made cars go through the tunnels and saw that the stair pieces would fit together by reversing but couldn't always make it work. He said, "You help me " - meaning, I think, that he wanted an audience and comments. He piled a tower "as high as Danny's tummy... shoulder ... chin ... then as tall as Danny." I provided the language while he measured himself against the tower. He enjoyed putting the blocks away, putting the same kinds together, after I had made a start. He said, "I want to do that." He brought a triangular block to me, feeling the various sides which have different textures due to the grain, and said, "Feel ... It's soft on this side," meaning smooth.

Speech is growing in clarity. As yet he is not sure of any colour name. When helping him dress for home I talk about his green sweater and his red mittens.

If one compares the above observations with the stages of development on the chart, one finds that Danny is in transition between the preoperational and the intuitive levels. In a one-to-one relationship with an adult he can trust; he also reveals transition between autonomy (I am what I can do) and initiative (I am what I can imagine I can do). When he is faced with the larger world of kindergarten, will these developments continue?

Once Danny arrives at school, he is no longer the single focus of attention. The teacher unavoidably sees him as a part of the whole class and his behaviour is often seen in relationship to the behaviour of others in the class. Under these conditions it is much more difficult to identify his uniqueness in development. No teacher can make an intense observation of each child in her class in any one day. At best, she may have the expertise to focus on four or five children in a day, while making mental notes of the others "on the fly". The habit of jotting down significant observations at the time they are made can prove invaluable. Such observations can be filed along with samples of the child's creative work. Thus the teacher can always refer to information that recalls to mind the child's previous behaviour and actions - in effect, she has a record of the child's behaviour.

Case Study 2

Student: Mary, age 6 years and 10 months.

Observer: Classroom teacher with 5 years' experience.

Situation: A large city school. The class has 34 children, age 6, and comprises 8 nationalities, 5 reading groups, 6 learning centres, and 2 teaching areas. The program is very organized from the teacher's point of view, but appears unstructured to the children.

Comments

Mary was a very shy child (and still is) who made no approaches to me. She never talked to me and never talked to the other children. An interview with Mary's mother made me realize that I may have been missing this child, so I started giving her as much "extra" attention as possible. Her pictures became much more detailed and her language became more fluent. Her drawings show children in houses. There are always doorknobs on the doors and heavy fences around the houses. Her stories are about children indoors waiting to get out. I put her with the most able reading group and she's a much happier child but still not talking much. She's always apprehensive about starting new things. She'll say, "I need help with the first word." What I've done now is have another child help her as I think that might be better than always coming to me. She is beginning to approach me more freely and she now smiles more often.

Although Mary's drawings and stories indicate that she is able to represent her feelings and interpretations of the world, she will be able to reveal the specific stages of her intellectual development only when she has developed sufficient trust to show either initiative or autonomy in her own play activity. Presently she is learning to trust an adult and a classmate.

By contrast, the study of Shawn reveals that he has "learned to manage his world in his own terms". However, both the actions and words with which he accomplishes this are a concern to the teacher in the context of his overall development.

Case Study 3

Student: Shawn, age 6 years, the second eldest of 5 children, now in a foster home.

Observer and Situation: The same teacher and class as Mary's, above.

Comments

Shawn is physically immature. In a social context, his main response to adults and children consists of hitting and kicking. I was working one day on his self-image; I asked him who he liked.

Shawn: Mrs. Wade (lay assistant in kindergarten last year).

Teacher: Why do you like Mrs. Wade?

Shawn: I guess 'cause she loves me.

Teacher: Why do you think she loves you?

Shawn: (hesitantly) I think she loves me 'cause I smiled.

This shows you how aware he is. It's this awareness that gets him into trouble, because he has a quick temper. When he doesn't feel loved, he responds dramatically... . The amazing thing is that he is learning to read. When he had a small sight vocabulary, I put him on dictated stories. He gets his sight vocabulary quickly: when he had the word club, he figured out the new word cup almost without help. In two or three minutes alone with me, he can learn what it takes another child two or three days to learn.

With peer relationships we have another story. Every time he saw a building (in the block centre), he smashed it. Then I legalized his behaviour by calling him "Mr. Teperman" (a demolition company). The children and I would call up Mr. Teperman when their buildings were finished. Shawn would come to the block centre as Mr. Teperman and really knock them down. Then I started questioning him before he reached the building. "Which block can you pull out to make the building fall this way?" I would ask, showing a direction. He immediately chooses

a block so that the building always falls on the carpet and reduces the noise level. This has made a lot of sense to him. Now he's using all sorts of good vocabulary. "If I pull this round one, this one will drop here and all these will cave in."

He's showing more and more self-control and watching the Lego work and doing a bit of it himself.

His drawings have been tired, angry, disconnected, but now he's doing better figure drawings. I still work on building up his self-image all the time. If he's having difficulty, I pick him up, hold him tightly until he relaxes, and then we talk.

Teacher: What's your name?

Shawn: My name's Shawn.

Teacher: How old are you?

Shawn: I'm six.

Teacher: Do you know why you're angry?

Shawn: Yes, you made me stop.

Teacher: Do you know why I did that?

Shawn: Yes, I broke the car and ran out of the room.

Teacher: What do you like to do?

Shawn: I like to play with the cars.

Teacher: What else do you like to do?

Shawn: I like to play with John.

Teacher: Is John your friend?

Shawn: Yes, he's my friend.

Teacher: Can you think why he likes you?

We talk about what he looks like, about his clothes, about what he and John like to do together, all in an attempt to improve his self-image.

Until Shawn is secure enough to build something with the blocks or Lego, to interact more positively with adults, particularly to question them (see intuitive stage), it is difficult to identify his real level of intellectual development. Meanwhile, the security he gets from his relationship with his teacher is motivating him to learn to read and is thus giving him a real sense of achievement.

Case Study 4

Student: Rosemary, age 6 years.

Observer: Classroom teacher with 3 years' experience.

Situation: A city school. The class of 25 children, age 6, is divided into four reading groups. There are a number of learning centres in the room, one of which contains a quantity of materials for manipulating, sorting, and sequencing. A few

of the teacher's observations regarding Rosemary's activities with these materials over a period of several months are listed below.

Nov. Matrioska doll. As she took out one doll, she would be very surprised to find another. She immediately saw the sequence of sizes.

Dec. Matrioska doll. Rosemary put the dolls in order from large to small. "The mother is going down, and down, and down." She could reverse the sequence and nest the dolls.

Jan. 22-ringed cone. Rosemary sequenced the cone, large to small. She took the rings and put them in a row. "I made a Christmas tree. I took not the first one but the second one each time and I put them in a pile of their own." The cone had two large to small sequences. Rosemary made a colour pattern with the cone - big, medium, little, big, medium, little...

Unifix. Rosemary made a train track.

Feb. Unifix. "I made my favourite long snake. I counted them (the connecting units). There are 258." Rosemary was shown a pattern of Unifix cubes put together in rods, increasing by 2 each time. She then made a pattern of her own, showing 1 - 3 - 5 - 5 - 3 - 1.

22-ringed cone. "I took not the first, but the second, not the third, but the fourth. I missed one all the

time and then I went back and started with the first." The pattern was large to small, small to large. Next she made the colour pattern large to small, after which she took them off and reversed the 3 rings of each colour, small to large.

Mar. Unifix. Rosemary made a continuous Unifix pattern of 3 blue, 1 orange, then made a stair starting with 1 and increasing by 2 each time to 15. She represented this on graph paper.

May 22-ringed cone. Rosemary made an interesting pattern with one set, starting biggest at the bottom, decreasing in size going up, interwoven with a second set decreasing in size going down.

In many of the above observations, Rosemary's actions and language indicate that she is functioning at the early concrete operational level of intellectual development in some areas, and at the stage of industry in psycho-social development. It is clear that Rosemary's active work with materials is the means whereby she is able to continuously refine her perceptions. As she works, she is thinking, anticipating,and reflecting, thus gradually developing the ability to think logically.

Developmental stages are sequential - that is, each child must pass through each stage consecutively. This does not necessarily mean, however, that these stages are co-related with

specific levels. The school curriculum may favour an age-grade program which fails to consider the maturational stage of the individual child and the mode of learning inherent in each stage. The child cannot "skip" a stage; his intellectual development continues only when he is able to function at his current level of learning. His psycho-social development may be seriously affected when he is forced to operate at a later or earlier stage.

Case Study 5

Student: Clara, age 10 years, 3 months.

Observer: Classroom teacher of wide experience.

Situation: Rural central school. Special class for 8 children with emotional and learning difficulties. Beginning in September, part of each day was spent in free activity.

Oct. Clara put the rings of the sequential cone in random order. She was successful in matching the items in the sorting box and putting each set of 4 items in order of size. She tried to arrange them in other ways.
(Note: Other observations indicated that Clara has difficulty in controlling size relationships, although she enjoyed working with the materials, turning sequenced rods into houses and barns.)

Nov. Clara arranged the wooden shapes randomly but made some colour selections.

Dec. Working with Jim (11 years), she sorted out all the sequenced thin sticks and counted them. Then she helped Jim order the thick sticks, small to large, when he was unable to complete the arrangement. Did much rearranging.

Clara is still putting the rings on the cone in random order. She used the coloured solid shapes to make a clown's face. She then used graph paper to represent what she had done.

Jan. With the inch cubes Clara made a post office with steps leading to the door.

Feb. Clara made stairs with nine of the colour factor rods, starting with the smallest.

Mar. After seeing some pattern cards, Clara worked with pencil crayons on the centimetre squared paper. She had some trouble at first, but eventually produced four repetitions of the number sequence 8, 7, 2, in blue, purple, and red, with the numerals written below the baseline.

Apr. Clara put the sequenced felt strips in order on the square base (from large to small) without difficulty. She had a great deal of difficulty in trying to arrange them from small to large (reversibility). Later, after recess, she put the felt strips in horizontal order from 10 to 1 and then from 1 to 10.

May By now Clara is able to produce both horizontal and vertical patterns in sequential order and to represent her patterns on squared paper. At the beginning of the year her paper effort had been a crude scribble.

Initially, Clara was functioning at the preoperational level. Only when she felt free to handle materials as she wished, did she reveal autonomy; then she moved quickly into initiative, shown in her eagerness to help Jim. By April, she had moved into the early concrete operational stage, shown in her achievement in sequencing.

Clara's development illustrates that an older child whose development has been suppressed can make relatively rapid gains when she is given the opportunity to function at her own level. The above observations represent only a segment of Clara's total classroom activities. The opportunity to engage freely in social play was particularly important to Clara's development.

Teachers at the Junior level have an even wider range of developmental stages to contend with than Primary teachers. Somewhere in an Ontario classroom, a teacher is faced with a "lazy boy", aged 12. Referring to the chart, the teacher may assume that this child should somehow fit into the concrete operational stage. She might well question the validity of Industry (a sense of industry acquired through elimination of a sense of inferiority) and move down to the earlier

Psycho-social level (early industry - anxious to do things well) only to reject this also since the child does nothing well of his own volition. Thus a still earlier stage - Initiative - needs to develop his own powers to be accepted for himself - must be considered. This was Clara's stage and her teacher acted accordingly. Would a similar approach work for "a lazy boy"?

From the concrete operational stage onward, the language (oral and written) that a child uses creatively becomes an additional indicator of his intellectual stage of development. Children aged 11 and 12 were asked to explain what they understood by the concept of energy. Some tried to define it by relating it to their personal experience, using the language that they frequently hear. These answers reflect no logical thought on the part of the children.

- Energy is power. Something you use when you do something.
- Energy is something powerful and strong and you can do a lot of strong and difficult things.
- Energy is having power to run or to do 65 push-ups. It's having strength.
- Energy is strength that you build up as the years go by.

A few children indicated some awareness of the function of energy or of cause and effect relationships, but again the language is borrowed from convention and does not represent the child's logical thought.

- Energy is power. Energy helps produce light. Energy helps us live. Some people have more energy than others.
- Energy is a source of power that is produced by man or machine. It helps make life easier.
- Energy is something you use every day. Electricity is energy.
- Being able to run far, or lift a lot of weight like an energy pill. You should try them, chocolate-flavour pills.

Another child was able to be more explicit because he recognized that a concrete substance was involved in the cause-effect relationship.

- Energy is the form that keeps things warm and going such as gasoline, oil, and such. Energy is the amount of push and pep in all living things, bodies.

Another boy, nearly thirteen, came closest to a logical explanation:

- Energy? I don't really know because it is very difficult to explain. I could explain it with a steam engine. When they had steam engines, people lit the fire in the fire-box which heated water to make steam. The steam moved pistons that caused the wheels to turn and that was an example of energy.

Although the concept of energy is too abstract for many children, they nevertheless attempt an answer. Because the last example gives a logical explanation, it could be assumed that this boy is moving towards the formal operational stage. To a certain extent, however, his example could be interpreted as an indication of his ability to reproduce language to the satisfaction of the questioner. More positive evidence of this boy's stage of development is revealed as he explains a model 'ornithopter' that he is building.

- I'll explain how it works. You wind up the rubber band with the crankshaft. On the wings which are flexible - they can move up and down freely - there are two long wire loops and the crankshaft goes through these. When it unwinds, the movement of the crankshaft causes the wings to flap up and down. The ornithopter flies because there is a loose piece of tissue attached to the main spar of the wings. When the wings flap up and down this creates lift and propulsion because all the excess air rushes out the back of the wings. Propulsion is the force that causes something to move. The most common type is a propeller in an airplane but in this case it is the wings.

Logical thought evolves from the child's work and experimentation with concrete materials. An adult can choose effective strategies for teaching a child only by finding out how the child functions. By observing the child and interacting with him,

the adult can gather evidence that will assist him in his assessment of the child's development; the complexities of childhood chart may help to reaffirm his observations.

A Child's Eye View by Mary Sime (Oxford, 1973) gives a comprehensive explanation, in a classroom setting, of the Piagetian stages of intellectual development from early childhood to adolescence.